Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, Alaska 99501

Total Maximum Daily Loads (TMDLs) for Petroleum Hydrocarbons in the Waters of Dutch Harbor and Iliuliuk Harbor in Unalaska, Alaska

Final

July 2010

Approved by the EPA September 16, 2010

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

SEP 16 2010

Ms. Lynn J. Tomich Kent
Director Water Division
Department of Environmental Conservation
555 Cordova St.
Anchorage, Alaska 99501-2617

Re: Approval of the Dutch Harbor and Iliuliuk Harbor Petroleum Hydrocarbons TMDLs

Dear Ms. Kent:

The Alaska Department of Environmental Conservation (ADEC) submitted the Dutch Harbor and Iliuliuk Harbor Total Maximum Daily Loads (TMDLs) for Petroleum Hydrocarbons to the U.S. Environmental Protection Agency on August 6, 2010, and was received August 10, 2010. Following our review, EPA is pleased to approve the petroleum hydrocarbon TMDLs for Dutch Harbor and Iliuliuk Harbor [Alaska ID Numbers 30401-601 and 30102-602] in Unalaska Bay, Alaska.

Our review indicates that these load allocations have been established at a level that, when fully implemented, will lead to the attainment of the water quality criteria addressed by these TMDLs. Therefore, ADEC does not need to include Dutch Harbor and Iliuliuk Harbor on the next 303(d) list of impaired waters for the pollutants covered by these TMDLs.

We greatly appreciate the opportunity to work with your staff throughout the development of these TMDL. In particular, we are impressed by the commitment and hard work shown by Laura Eldred of ADEC in developing these TMDLs.

By EPA's approval, this TMDL is now incorporated into the State's Water Quality Management Plan under Section 303(e) of the Clean Water Act. We look forward to continuing to work collaboratively on water quality issues in Dutch Harbor and Iliuliuk Harbor. If you have any questions, please feel free to call me at (206) 553-4198, or Martha Turvey of my staff at (206) 553-1354.

Sincerely,

Christine Psyk for

Michael A. Bussell, Director
Office of Water and Watersheds

cc: Ms. Laura Eldred, Restoration and Protection Section, ADEC
Ms. Cindy Gilder, Manager, Restoration and Protection Section, ADEC
Ms. Nancy Sonafrank, Manager, Non-Point Source Water Pollution Control Program, ADEC

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Acronyms

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
APL	American President Lines
AST	above-ground storage tank
AWCRSA	Aleutians West Coastal Resource Service Area
BMP	best management practice
BTEX	benzene, toluene, ethylbenzene, and xylenes
CFR	Code of Federal Regulations
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
ERL	effects range-low
ERM	effect range-medium
FRP	facility response plan
LA	load allocation
LUST	leaking underground storage tank
MOS	margin of safety
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PEL	Probable Effects Level
SPCC	spill prevention, control and countermeasure
SWPPP	stormwater pollution prevention plan
TAH	total aromatic hydrocarbons
TAqH	Total aqueous hydrocarbons
TEL	Threshold Effects Levels
TMDL	total maximum daily load
TOC	total organic carbon
UMC	Unalaska Marine Center
USACE	U.S. Army Corps of Engineers
UST	underground storage tanks
WLA	wasteload allocation

Total Maximum Daily Load (TMDL) for

Petroleum Hydrocarbons in

Dutch Harbor and Iliuliuk Harbor, Alaska

Water Quality Limited?	Yes
Alaska ID Number:	30401-601 and 30102-602
Criteria of Concern:	Petroleum Hydrocarbons – specifically polycyclic aromatic hydrocarbons (PAHs) in bottom sediments
Designated Uses Affected:	Aquaculture; seafood processing; contact recreation; secondary recreation; growth and propagation of fish, shellfish, other aquatic life, and wildlife.
Major Source(s):	Historical spills and current operations at docks and harbors.
Loading Capacity:	1,684 µg/kg
Wasteload Allocation:	Not applicable
Load Allocation:	1,515.6 µg/kg
Margin of Safety:	Explicit 10 percent (168.4 µg/kg) and implicit assumptions
Necessary Load Reduction:	Varies by allocation area (see below)

Impairment Area	Sub-area	Total PAHs (µg/kg)					Percent Reduction
		Loading Capacity	WLA	LA	MOS	Maximum Observed	
Dutch Harbor	Ballyhoo Spit	1,684.0	NA	1,515.6	168.4	6,586	77.0%
	Northern Dutch Harbor	1,684.0	NA	1,515.6	168.4	14,560	89.6%
	Rocky Point	1,684.0	NA	1,515.6	168.4	11,659	87.0%
Iliuliuk Harbor	Southwest Iliuliuk Harbor	1,684.0	NA	1,515.6	168.4	112,840	98.7%
	Small Boat Harbor	1,684.0	NA	1,515.6	168.4	5,210	70.9%
	Central Iliuliuk Harbor	1,684.0	NA	1,515.6	168.4	94,455	98.4%
	Northern Iliuliuk Harbor	1,684.0	NA	1,515.6	168.4	99,569	98.5%

WLA = wasteload allocation
LA = load allocation
MOS = margin of safety

Executive Summary

Dutch and Iliuliuk Harbors are ports located in Unalaska Bay that serve the greater Unalaska area, which includes the City of Unalaska, Unalaska Island, and Amaknak Island. Greater Unalaska is part of the Aleutian Island chain that stretches west across the Bering Sea from Alaska's west coast. Dutch Harbor is an international port located on the east coast of Amaknak Island. Amaknak and Unalaska Islands are separated by Iliuliuk Bay, which is adjacent to Dutch Harbor and connects to Iliuliuk Harbor located to its south. Iliuliuk Harbor is a seaport similar to Dutch Harbor and is formed by the convergence of Amaknak and Unalaska Islands moving south from Iliuliuk Bay.

The State of Alaska first listed Iliuliuk Harbor on its 1990 303(d) list as impaired due to non-attainment of the water quality standards for petroleum hydrocarbons and oil & grease for petroleum products. A 303(d) listing of Dutch Harbor for the same impairment followed in 1994. Monitoring conducted by the Alaska Department of Environmental Conservation (ADEC) in 2007–2008 found that Dutch and Iliuliuk Harbors remain impaired for petroleum due to oil sheens on sediments. Results of the follow-up sampling also found that Iliuliuk Bay, originally listed in 1990 for non-attainment of the petroleum hydrocarbons and oil & grease standard, now meets applicable water quality standards, and ADEC is in the process of delisting the waterbody. (Please note: Even though Iliuliuk Harbor lies within Iliuliuk Bay, the two will be referenced as separate locations.) Surface water quality in Dutch Harbor and Iliuliuk Harbor currently meets applicable water quality criteria for petroleum hydrocarbon concentrations. Sediment contamination is thought to be the result of historic spills and releases on the uplands and on water, which have been spread throughout the area by rain, wind, and tidal and wave action (OASIS 2006).

This Total Maximum Daily Load (TMDL) establishes limits for total polycyclic aromatic hydrocarbons (PAHs) entering Dutch and Iliuliuk Harbors. A TMDL represents the amount of a pollutant the waterbody can receive while maintaining compliance with applicable water quality standards. The TMDL is based on existing sediment contamination levels and is established to meet the requirements of Section 303(d)(1) of the Clean Water Act. A TMDL is composed of individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background loads. In addition, the TMDL must include a margin of safety, either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody.

Historically, the City of Unalaska and the area port facilities were used extensively as part of United States Armed Forces during World War II. The area served as a forward operations base and included large tank farms used for fuel storage and transfer. To protect them from serious damage during Japanese bombing raids, storage tanks were quickly drained sometimes causing petroleum fuel spills. Japanese bombing operations also caused the destruction of several fuel storage tanks causing the release of more than one-million gallons of petroleum. Currently, Dutch and Iliuliuk Harbors are major traffic areas for the shipping and seafood industries. Industry operations, including fueling and fuel transfer activity, have also resulted in petroleum spills to surface waters. Though monitoring studies conducted in 2007–2008 show that surface waters are currently meeting applicable water quality standards for petroleum hydrocarbons, areas in Dutch Harbor and Iliuliuk Harbor are considered impaired due to oil sheens in sediments.

The ADEC developed this TMDL using applicable marine water quality criteria for petroleum hydrocarbons and oil and grease, which state in various forms that "…surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen or discoloration." Because this standard is narrative, ADEC used the numeric toxicological screening criteria presented in the National Oceanic and Atmospheric Administration (NOAA) *Screening Quick Reference Tables* (Buchman 1999) to establish the numeric target for this TMDL.

For the TMDL target, ADEC used the conservative toxicity limit known as the Threshold Effects Level (TEL). TELs define chemical sediment concentrations below which toxic effects are rarely observed in sensitive species. TEL guidelines are available for PAHs. Petroleum contamination in water and sediment is often assessed as total aqueous hydrocarbon concentrations, which is the sum of PAHs and total aromatic hydrocarbons (TAHs) concentrations. TELs are not available for TAHs, but recent monitoring has shown that sediment TAH concentrations are below detectable levels (OASIS 2009).

Because there are currently no permitted sources discharging petroleum hydrocarbons to Dutch or Iliuliuk Harbor, the waste load allocations for this TMDL are not applicable. This results in the entire available loading capacity (minus 10 percent for the margin of safety) being allocated to nonpoint sources as the load allocation. Any future facilities permitted to discharge petroleum hydrocarbons will be subject to the water quality standards, permit limits and other applicable laws or regulations. The applicant would need to demonstrate that the proposed discharge will not negatively impact the sediment quality with total PAHs in the impaired areas. The TMDL establishes an allocation for future sources equivalent to the load allocation to ensure that any future sources also meet established sediment quality targets. The TMDL also establishes an implicit margin of safety based on the conservative TEL target.

The TMDL indicates the need for consistent development and the application of best management practices at docks and harbors to minimize the potential for fuel and oil spills in the study area. In addition, monitoring should continue to determine whether natural recovery is occurring and concentrations of petroleum contaminants are decreasing over time due to natural sedimentation processes. Monitoring will allow ADEC to track the progress of changes in water and sediment and determine whether acceptable progress is being made. Monitoring could also include further evaluation of potential stormwater sources and bioassays to determine whether petroleum-impacted sediments are having a deleterious effect on benthic communities.

1. Overview

Section 303(d)(1)(C) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) implementing regulations (40 CFR Part 130) require the establishment of a Total Maximum Daily Load (TMDL) for the achievement of state water quality standards when a waterbody is water quality-limited. A TMDL identifies the amount of a pollutant that a waterbody can assimilate and maintain compliance with water quality standards. TMDLs include an appropriate margin of safety and identify the level of pollutant control needed to reduce pollutant inputs to a level (or "load") that fully supports the designated uses of a given waterbody. The mechanisms used to address water quality problems after the TMDL is developed can include a combination of best management practices (BMPs) and/or effluent limits and monitoring required through National Pollutant Discharge Elimination System (NPDES) permits.

Dutch Harbor and Iliuliuk Harbor are seaports located in the greater Unalaska area, Alaska, which includes the City of Unalaska, Unalaska Island, and Amaknak Island. Greater Unalaska is part of the Aleutian Islands chain that extends off Alaska's west coast separating the Bering Sea and Pacific Ocean (Figure 1-1). This document summarizes the available monitoring and pollutant source data for Dutch and Iliuliuk Harbors and presents TMDLs to address petroleum impairments in the two impaired waterbodies.

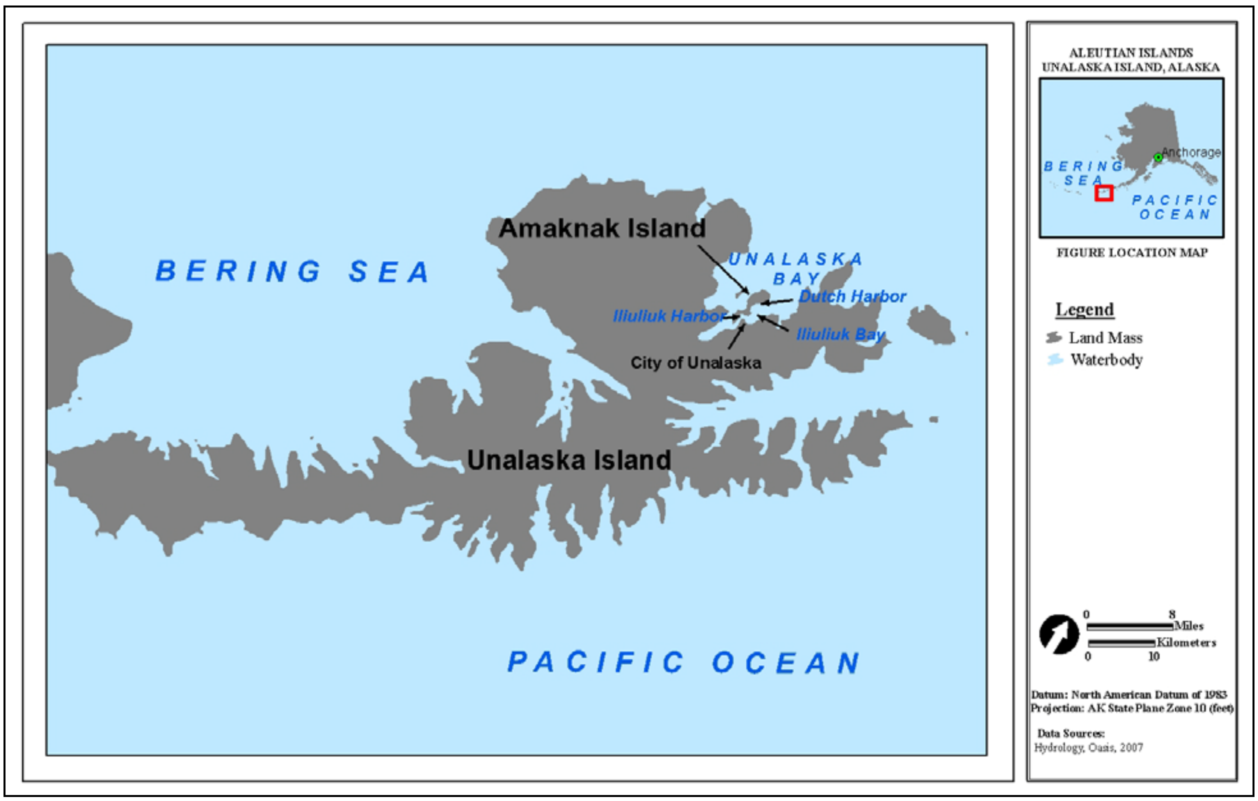

Figure 1-1. Study area general location

In 1994 Alaska Department of Environmental Conservation (ADEC) included Dutch Harbor on its 303(d) list as impaired for petroleum hydrocarbon pollution. The initial Dutch Harbor listing was based on follow up investigations related to the 1990 303(d) listing of adjacent Iliuliuk Bay and Harbor and observed sheens and reports of numerous petroleum spills in the waterbodies. The observed sheens caused violations of the state water quality standard, which states in various forms that petroleum hydrocarbons "may not cause a visible sheen on the surface of the water" [18 Alaska Administrative Code (AAC) 70.020(b)(5)]. Table 1-1 summarizes the information included in Alaska's approved 2008 303(d) list for Dutch Harbor, Iliuliuk Bay, and Iliuliuk Harbor. As an update to information included in the 2008 list, a follow-up sampling event was also conducted in September 2008, in addition to the sampling noted for April and September 2007. These sampling events found that Dutch Harbor and Iliuliuk Harbor failed to meet the narrative water quality criteria for petroleum and TMDLs will be required. Results of the follow-up sampling found that Iliuliuk Bay meets applicable water quality standards and ADEC is in the process of delisting the waterbody.

Table 1-1. Summary of 303(d) listing information for Dutch Harbor and Iliuliuk Harbor from ADEC's 2008 Integrated Report

<table>
<tr><th>Alaska ID Number</th><th>Waterbody</th><th>Area of Concern</th><th>Water Quality Standard</th><th>Pollutant Parameters</th><th>Pollutant Sources</th></tr>
<tr><td>30401-601</td><td>Dutch Harbor</td><td>0.5 acre</td><td>Petroleum Hydrocarbons, Oil & Grease</td><td>Petroleum Products</td><td>Industrial, Urban Runoff</td></tr>
<tr><td colspan="6">This waterbody was Section 303(d) listed in 1994 for non-attainment of the petroleum hydrocarbons, oil & grease standard for petroleum products. The August 25, 1994 Water Quality Assessment for Greater Unalaska Bay determined the waterbody was impacted by petroleum products. A more specific waterbody assessment for Dutch Harbor is needed to validate the water quality issues and determine whether additional controls are necessary. Existing data compilation was completed in 2006. Initial field sampling event conducted in April 2007 included water column and sediment samples for benzene, toluene, ethylbenzene, and xylenes (BTEX), polycyclic aromatic hydrocarbon (PAH) & total organic carbon (TOC). A follow-up sample event was conducted in September 2007. These sampling events and data may lead to the development of a TMDL.</td></tr>
<tr><td>30102-602</td><td>Iliuliuk Bay/Harbor</td><td>1.4 acres</td><td>Petroleum Hydrocarbons, Oil & Grease</td><td>Petroleum Products</td><td>Urban Runoff</td></tr>
<tr><td colspan="6">This waterbody was Section 303(d) listed in 1990 for non-attainment of the petroleum hydrocarbons, oil & grease standard for petroleum products. An EPA August 1994 Water Quality Assessment for Greater Unalaska Bay which included Iliuliuk Harbor/Bay concluded that Iliuliuk Harbor/Bay is impacted by intermittent spills for petroleum products and chronic sewage runoff. Anchorage DEC staff indicates the waterbody is regularly affected by petroleum spills and that until the controls resolves the petroleum spills/seeps problem, the waterbody should remain Category 5/303(d) listed. TMDL existing data compilation completed in 2006. The initial field sampling event conducted in April 2007 included water column and sediment samples for BTEX, PAH & TOC. A follow-up sampling event occurred in September 2007. Anticipate petroleum TMDL development or removing for Section 303(d) list by June 30, 2009.</td></tr>
</table>

2. Watershed Background

2.1. Location and Physical Setting

Dutch Harbor and Iliuliuk Harbor are located in the greater Unalaska area that spans two islands of the Fox Islands group in the middle of the Aleutian Islands chain, approximately 763 miles southwest of Anchorage, Alaska. The Aleutians extend southwest away from the Alaskan mainland and separate the Bering Sea and Pacific Ocean. Amaknak Island, the smaller of the two islands, is tucked into a large inlet that forms Unalaska Bay on the north, or Bering Sea, side of the larger Unalaska Island (Figure 1-1).

The topography of its complex shoreline and islands divides greater Unalaska Bay into a number of continuous waterbodies. Iliuliuk Harbor, on the southeast side of Amaknak Island, is a shallow and largely enclosed portion of Iliuliuk Bay, which, along with neighboring Dutch Harbor, is a part of greater Unalaska Bay. Amaknak and Unalaska Islands are connected by a bridge that delineates the south end of Iliuliuk Harbor where it connects to Captains Bay, another waterbody within Unalaska Bay.

To the north and east of Iliuliuk Harbor, Iliuliuk Bay lies between Amaknak Island and the eastern shore of Unalaska Bay. Rocky Point, a portion of Amaknak Island that forms a peninsula in Iliuliuk Bay, creates the eastern entrance to Iliuliuk Harbor where it meets with the western edge of the City of Unalaska, located on Front Beach.

Dutch Harbor lies adjacent to Iliuliuk Bay, along the eastern shore of Amaknak Island, north of Rocky Point. Iliuliuk Bay and Dutch Harbor constitute a single basin bordered by a sill (pronounced elevation in the sea floor) extending from the Dutch Harbor (Ballyhoo) spit east to Unalaska Island on its north side and by the convergence of Amaknak Island and Unalaska Island and shallower Iliuliuk Harbor to the south (USEPA 1994). Figure 2-1 shows the major land and water features of the study area and Figure 2-2 through Figure 2-7 present photographs of select locations taken by ADEC.

The terrain of Unalaska Island is characterized by steep, rugged mountains that rise abruptly from the shoreline in most areas. In contrast, portions of Amaknak Island are relatively level and much of the current development is located on that island. The vegetation of the area is typical of the treeless southern Alaska Peninsula and eastern Aleutian Islands and is dominated by grass and shrubs. One large freshwater stream, the Iliuliuk River, which drains Unalaska Lake, flows into the study area near the eastern entrance to Iliuliuk Harbor and is used by salmon for spawning.

Tides in greater Unalaska Bay are relatively small. The mean tidal amplitude is approximately one meter and the maximum tidal amplitude is about three meters. A water circulation study of greater Unalaska Bay (CH2M-Hill 1994) indicated that the water circulation in the bay is driven primarily by winds (90%) and secondarily by tides (10%). This results in currents that are strongly seasonal and weakly demidiurnal in direction and velocity. On a large scale, the modeling of circulation in greater Unalaska Bay indicates wind-driven currents are 5 to 15 cm/sec, while currents in the deep basins of Dutch Harbor-Iliuliuk Bay may be less than 1 cm/sec during much of the year. Water circulation in the deep basins is also seasonally restricted due to a stratified water column and the absence of appreciable currents in the bottom layer (USEPA 1994).

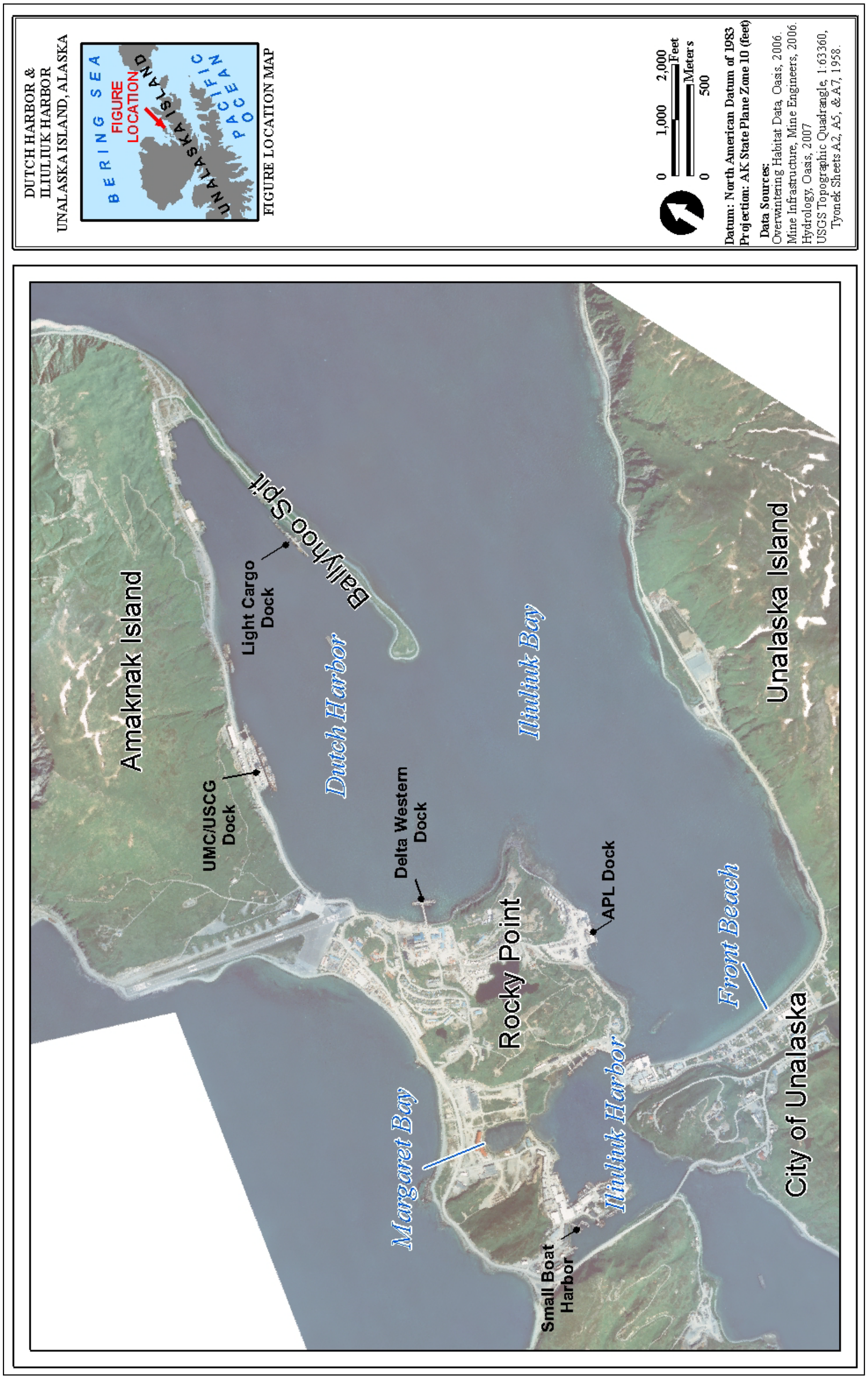

Figure 2-1. Dutch Harbor study area location

Figure 2-2. Dutch Harbor overlooking the Light Cargo Dock located on Ballyhoo Spit

Figure 2-3. Iliuliuk Bay looking south towards the City of Unalaska and Front Beach

Figure 2-4. The northern end of Dutch Harbor

Figure 2-5. Rocky Point, looking north towards Dutch Harbor

Figure 2-6. Looking west over a portion of Iliuliuk Harbor with the small boat harbor in the center and the former submarine repair facility in background

Figure 2-7. A portion of the small boat harbor, looking southeast towards the southern entrance of Iliuliuk Harbor

2.2. Climate

The eastern Aleutian Islands are within the Alaskan maritime climate zone, which is characterized by cool summers and mild winters. Low-lying fog, overcast skies, rain, and drizzle dominate weather conditions due to air masses over the warmer Pacific Ocean mixing with chilled air over the colder Bering Sea. Normal summer air temperatures range between 43 to 53 degrees Fahrenheit (F), while mean winter temperatures range between 25 to 35 degrees F. High summer temperatures may reach 84 degrees F for brief periods and low winter temperatures may fall to 10 degrees F. During brief periods of cold winter weather, ice up to five centimeters thick can form on Iliuliuk Harbor, but the other bays in the area remain ice free throughout the year. The average annual precipitation for the area is approximately 57.7 inches and the mean wind speed is 15 knots (AWCRSA 2003).

The area is well-known for adverse and, oftentimes, extreme weather conditions. Unalaska is in the path of frequent west-to-east storm tracks of the North Pacific, especially in winter. Winds in winter storms are usually strong, and high winds (110 to 125 miles per hour) occur from time to time, particularly in the isthmus area on Amaknak Island (AWCRSA 2003).

2.3. Cultural History and Historical Activities

The first people to settle the Aleutians probably crossed the Bering Land Bridge some 10,000 to 15,000 years ago from Asia to North America. They called themselves Unangan or Unangas, meaning “people of the places.” The Unangans relied upon the coast and the sea for their livelihood, hunting, fishing, gathering food and making clothing and tools. Villages were always built on the seacoast, situated where natural resources were abundant and easy to obtain near salmon streams and on protected bays and coves. The population distribution in the Aleutians at the time of contact with Europeans in 1741 is estimated at 12,000 to 15,000 (AWCRSA 2003).

The first recorded contact with Russian explorers in the Unalaska area occurred in 1741 when Unalaska and Amaknak Islands had an Unangan population estimated to be over 3,000 people, dispersed in twenty-four villages. The village on Iliuliuk Bay, site of the present day City of Unalaska, was a pre-contact village called “Agunalaskh.” Between 1766 and 1772, the Russians established a trading post there for the fur seal and otter fur industry . The Russian traders enslaved most of the Unangan population to harvest otters for the fur trade. During the height of the fur trade, the Russians transported many Unangans from Unalaska to the Pribilof Islands to harvest fur seals. The Unangan population rapidly declined after contact with the fur traders (AWCRSA 2003). After the purchase of Alaska in 1867, the United States government took over the fur seal trade from the Russians and continued it for 100 years.

Seafood processing of salmon, herring, and salt cod was established in the early 1900s, and by the late 1920s, the area supported a major herring fishery. The military presence in Unalaska ramped up with the beginning of World War II, and by 1943 the peak military population reached between 50,000 and 70,000 and included an extensive network of facilities (AWCRSA 2003).

On June 3, 1942, Japanese planes bombed Unalaska, killing 43 people and destroying infrastructure, including fuel storage and transfer facilities. It is estimated that over one-million gallons of petroleum spilled into the Dutch Harbor-Iliuliuk Bay waters during efforts to drain fuel tanks on Rocky Point prior to the attack, and it is possible that current sediment contamination may be in part attributed to this legacy. In response to the attack the military repaired the damage in Dutch Harbor area and expanded facilities and defenses in the entire Unalaska Bay area, including the Dutch Harbor Naval Station and Fort Mears on Unalaska Island (AWCRSA 2003).

The military had a profound effect upon the lives of the Unangans during and after World War II. The Unangan people were evacuated by the Navy and taken to southeast Alaska where they lived in an abandoned cannery and other facilities for three years, suffering severe hardship and many deaths. Meanwhile, military personnel misused or vandalized many of the Native homes in Unalaska. Following the end of World War II, the military began withdrawing from the area, and by 1946 the bases were boarded up and equipment removed. The military presence ended in 1951 (AWCRSA 2003).

2.4. Current Economic Activity and Land Ownership

The post World War II period saw the development of the fishing and seafood processing industry in the region. Of all the communities located in the western Aleutian Islands, from the island of Unalaska westward to Attu Island, Unalaska has the most diversified and complex economy. Unalaska is the largest community in the western Aleutians. In 2000 the population was 4,283, making it the 11th largest city in Alaska. However, during the peak fishing and processing season in the winter, the population can increase to more than 10,000. The largest landowner in the community is the Ounalashka Corporation, the Native village corporation of Unalaska, Alaska, formed in 1973 under the Alaska Native Claims Settlement Act.

The Unalaska economy is recognized as a driving force in the economy of the western Aleutians, both as an international trade center and a regional transportation hub. Commercial fishing and fish processing are the major economic components, and the fishing and port-related service sectors are well developed. Historically, fishing and fish processing in Unalaska were centered on the king crab fishery.
When that fishery was suspended in the early 1980’s due to overfishing, the fishing industry diversified into groundfish and related products such as surimi, resulting in a shift from seasonal to year-round economic activity. The port of Dutch Harbor in Unalaska has been ranked as the number one U.S. port in volume of commercial fish landed since 1988 (AWCRSA 2003).

Unalaska is strategically located on the Great Circle Route between northern Asia and the west coast of the U.S., allowing it to serve as a major cargo transfer station between Pacific Rim trading partners. In addition, the port serves as a productive transshipment center for cargo destined to and from locations in western Alaska and Anchorage, the West Coast and Asia. Seafood products from Bristol Bay, Akutan, and other seafood processing facilities in the region move by tug and barge to Unalaska where they are ultimately destined for the marketplace. Other important business sectors include service, repair and maintenance to the domestic and foreign fishing fleets and service to onshore and offshore based seafood processors. The use of the area as a major shipping hub and vessel service and maintenance center make it susceptible to petroleum pollution (AWCRSA 2003).

3. Water Quality Standards and TMDL Target

Water quality standards designate the "uses" to be protected (e.g., water supply, recreation, aquatic life) and the "criteria" for their protection (e.g., how much of a pollutant can be present in a waterbody without impairing its designated uses). TMDLs are developed to meet applicable water quality standards, which may be expressed as numeric water quality criteria or narrative criteria for the support of designated uses. The TMDL target identifies the numeric goals or endpoints for the TMDL that equate to attainment of the water quality standards. The TMDL target may be equivalent to a numeric water quality standard where one exists, or it may represent a quantitative interpretation of a narrative standard. This section reviews the applicable water quality standards and identifies an appropriate TMDL target for calculation of the petroleum TMDLs in Dutch Harbor and Iliuliuk Harbor.

3.1. Applicable Water Quality Standards

Title 18, Chapter 70 of the Alaska Administrative Code (AAC) establishes water quality standards for the waters of Alaska, including the designated uses to be protected and the water quality criteria necessary to protect the uses. Designated uses established in the State of Alaska Water Quality Standards (18 AAC 70) for marine waters of the State include (1) water supply, (2) water recreation, (3) growth and propagation of fish, shellfish, other aquatic life, and wildlife, and (4) harvesting for consumption of raw mollusks or other raw aquatic life and are applicable to all marine waters, unless specifically exempted. Table 3-1 lists water quality criteria for petroleum hydrocarbons, oils and grease.

Table 3-1. Water quality criteria for petroleum hydrocarbons, oils and grease (18 AAC 70.020)

Designated use	Description of criteria
(17) Petroleum hydrocarbons, oils and grease, for marine water uses	
(A) Water Supply	
(i) aquaculture	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L (see note a). Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.
(ii) seafood processing	May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
(iii) industrial	May not make the water unfit or unsafe for the use.
(B) Water Recreation	
(i) contact recreation	May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils.
(ii) secondary recreation	Same as (17)(B)(i) - contact recreation
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	Same as (17)(A)(i) - aquaculture
(D) Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	May not exceed concentrations that individually or in combination impart undesirable odor or taste to organisms as determined by bioassay or organoleptic tests.

In addition to the water quality criteria outlined in Table 3-1, Alaska has promulgated human health criteria in its *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (ADEC 2008). However, the criteria established for the protection of human health based on consumption of water and organisms are significantly greater than the TAqH (15 µg/L) and the TAH (10 µg/L) aquaculture criteria.

3.2. Sediment Quality Targets

To date, ADEC has not adopted numeric sediment quality standards for the evaluation of impacts to aquatic life. However, the ADEC Contaminated Sites Remediation Program has issued the technical memorandum *Sediment Quality Guidelines* (ADEC 2004), which recommends using the Threshold Effects Levels (TELs) and Probable Effects Levels (PELs) for evaluating sediment quality. TELs define chemical sediment concentrations below which toxic effects are rarely observed in sensitive species, while PELs define concentrations above which effects are frequently or always observed. Table 3-2 presents TELs and PELs applicable to petroleum hydrocarbon contamination, as summarized in the National Oceanic and Atmospheric Administration (NOAA) *Screening Quick Reference Tables* (Buchman 1999).

Table 3-2. Sediment quality screening level for petroleum hydrocarbon pollutants

Compound	TEL (µg/kg)	PEL (µg/kg)
Acenaphthene	6.71	88.9
Acenaphthylene	5.87	127.87
Anthracene	46.85	245
Benzo(a)pyrene	88.81	763.22
Benzo(a)anthracene	74.83	692.53
Chrysene	107.77	845.98
Dibenzo(a,h)anthracene	6.22	134.61
Fluoranthene	112.82	1,493.54
Fluorene	21.17	144.35
Naphthalene	34.57	390.64
Phenanthrene	86.68	543.53
Pyrene	152.66	1,397.6
Total PAHs	1,684.06	16,770.4

Source: Buchman (1999)

3.3. Impairments

Dutch Harbor and Iliuliuk Harbor are listed on Alaska's 2008 303(d) impaired list for violating state water quality standards for petroleum hydrocarbons and oil and grease. Petroleum products can cause a wide range of impairments to aquatic life and habitat, including lethal or sublethal effects. They have the potential to coat and smother organisms. Due to the lipophilic nature of petroleum products, they tend to reside in the fats and oils of organisms and are often found in the sediment rather than the water column. They also have the potential to change the physical properties of the sediment, contributing to indirect toxicity to aquatic life. The original 303(d) listings were based on observed sheens and reports of numerous petroleum spills in the waterbodies (OASIS 2006). Iliuliuk Bay and Dutch Harbor do not experience chronic sheens as in the past, and recent surface water monitoring has found that numeric water quality criteria for TAH and TAqH are currently being met (see Section 4). The study area remains listed as impaired, however, due to pervasive sediment petroleum contamination in tidal and subtidal areas.

The current impaired status of Dutch and Iliuliuk Harbors is based on violations of Water Supply and Water Recreation water quality criteria provisions, which state that "[petroleum hydrocarbons] may not cause a film, sheen, or discoloration on the surface or floor of the waterbody." Sediment petroleum contamination may also violate narrative provisions of the Water Supply and Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife water quality criteria, which state "there may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life."

As part of the TMDL development process, ADEC conducted research and review of available monitoring and source identification studies for the Dutch Harbor-Iliuliuk Harbor area that focused on sediment and surface water petroleum contamination. Results and conclusions of this effort are available in a June 2006 report, *Dutch Harbor Water Quality and Impairment Analysis*, available through ADEC. One of the goals of the 2006 analysis was to evaluate available data to identify potential sources of petroleum and define the suspected areas of impairment in the listed waters. The 2006 analysis identified three areas – Rocky Point, the northern Dutch Harbor, and the coastline of Iliuliuk Harbor – as being at risk for impairment or "impacted." Based on these conclusions a series of monitoring studies were designed to investigate and refine the potential areas of impairment. Conducted in April 2007, September 2007, and September 2008, these studies generally confirmed the impacted status of the three areas and further refined the areas of impairment within the impacted areas to locations near docks and harbors:

- **Rocky Point—** The impacted area identified in the 2006 assessment covers approximately 1.5 miles of coastline from the eastern end of the airport around the tip of Rocky Point and down past the American President Lines (APL) dock. Potential sources include contaminated sites associated with Rocky Point; Delta Western bulk fuel storage; Delta Western Dock and APL Dock where regular fueling activities occur; and the documented petroleum dock. The subsequent studies in 2007 and 2008 determined that the area of impairment is limited to waters in the vicinity of the Delta Western Dock.
- **Dutch Harbor—**The impacted area identified in the 2006 assessment includes the entire Dutch Harbor coastline, beginning at the eastern end of the airport and ending at the tip of Ballyhoo Spit. The area of impairment defined through the 2007 and 2008 studies consists of areas of Dutch Harbor, including the northern most waters enclosed by Ballyhoo Spit, which shelters this waterbody from open water. The impaired area covers approximately 1.1 miles of coastline, beginning near the North Pacific Fuel Dock and extending to the Light Cargo Dock on Ballyhoo Spit. Potential sources identified during the 2006 assessment include the former Mount Ballyhoo Spit Tank Farm; seafood processing at Icicle Seafoods; fuel storage and transfer at North Pacific Fuel Resoff Terminal; and fueling operations at the North Pacific Fuel Dock, Trident Seafoods Dock, and Light Cargo Dock.
- **Coastline of Iliuliuk Harbor—**The 2006 assessment identified coastline waters of this entire area as impacted. The area is surrounded by significant development around Expedition Island, Margaret Bay, and the tip of Unalaska Island, and potential sources include contaminated sites at Alyeska Seafoods, AT&T Alascom, former Fort Mears, and former Submarine Base / Ship Repair Facility; seafood processing at UniSea, Inc., and Alyeska Seafoods; and vessel activities at the Small Boat Harbor and Walashek Shipyard. The areas of impairment defined in the 2007 and 2008 studies are located around the former Submarine Base / Ship Repair Facility (now Walashek Shipyard), Small Boat Harbor, UniSea, Inc., and Alyeska Seafoods.

Results from the studies also indicated that Iliuliuk Bay is meeting water quality standards and provided the support for ADEC to propose delisting the bay. Figure 3-1 shows the impacted and impaired areas identified based on ADEC's analysis of the 2007–2008 monitoring results (OASIS 2009). Data showed that the waterbodies meet surface water quality criteria, but that sediments in the three priority areas are contaminated by petroleum hydrocarbons. (See Section 4 for a summary of the monitoring data and Section 5 for a summary of the identified sources.) Therefore, the TMDLs address the petroleum contamination in the bottom sediments of Dutch Harbor and Iliuliuk Harbor, focusing on the three priority areas of Rocky Point, northern Dutch Harbor, and the coastline areas of Iliuliuk Harbor.

3.4. TMDL Target

The TMDL target is the numeric endpoint used to evaluate the loading capacity and necessary load reductions and represents attainment of applicable water quality standards. The impairments in Dutch Harbor and Iliuliuk Harbor are caused by elevated concentrations of petroleum hydrocarbons in the bottom sediments. Because State of Alaska water quality standards include only narrative criteria related to sediment quality, it is necessary to identify an appropriate numeric sediment quality target that meets water quality standards and supports designated uses.

The ADEC Contaminated Sites Remediation Program has issued a technical memorandum *Sediment Quality Guidelines* (ADEC 2004), which recommends using the TELs and PELs, shown in Table 3-2, for evaluating sediment quality. TELs define chemical sediment concentrations below which toxic effects are rarely observed in sensitive species, while PELs define concentrations above which effects are frequently or always observed. These levels were used to evaluate impairment in the April 2007, September 2007, and September 2008 assessments.

To be consistent with the impairment assessments, the TMDL target is established equal to the TEL. In addition, because personal use fishing occurs in Iliuliuk Bay, Dutch Harbor and areas within Iliuliuk Harbor, it is appropriate to use the more protective threshold to ensure the maintenance of healthy populations of aquatic life. The TEL of 1,684.06 for Total PAHs will be used as the TMDL target. Petroleum contamination in water and sediment is often assessed as total aqueous hydrocarbon concentrations, which is the sum of PAHs and TAHs concentrations. TELs are not available for TAHs, and recent monitoring has shown that sediment TAH concentrations are below detectable levels (OASIS 2009). Therefore, PAHs were selected as the target parameter for calculating TMDLs for Dutch Harbor and Iliuliuk Harbor.

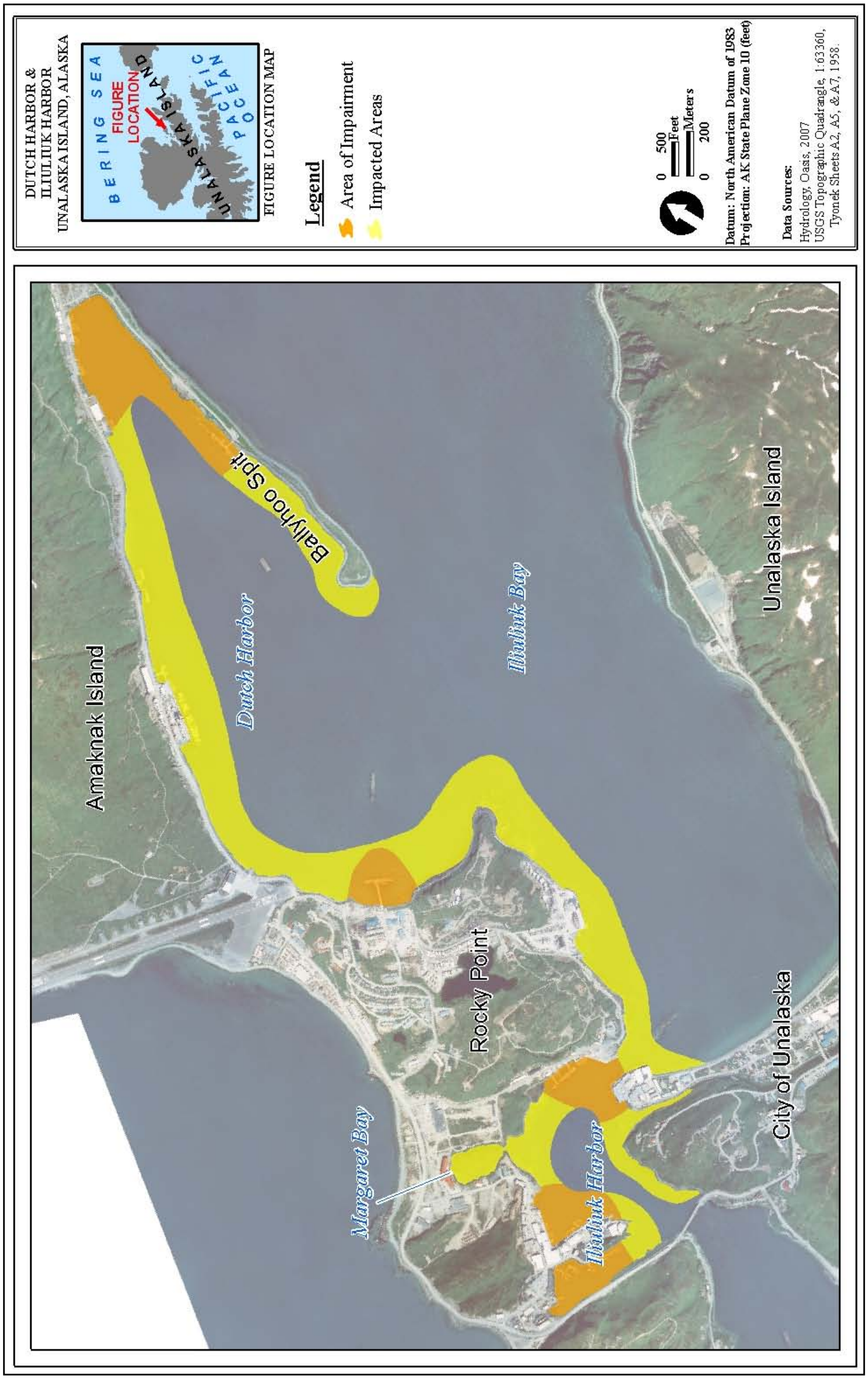

Figure 3-1. Impacted and impaired areas in the Dutch Harbor study area (OASIS 2009)

4. Data Review

This section outlines and summarizes the data available for Dutch Harbor and Iliuliuk Harbor relevant to the petroleum impairment. The summary includes historical studies and recent studies that investigated both sediment and water quality in the harbor.

4.1. Historical Studies

ADEC's *Dutch Harbor Water Quality and Impairment Analysis* (OASIS 2006) summarizes previous studies investigating the marine environment and water quality issues of the study area. These studies are summarized below. While the studies are not directly used in calculation of the TMDL, they provide support for historical sediment contamination and provide information on historical sources of petroleum products.

Surface Water

During the 2006 assessment, EPA's 1994 *Water Quality Assessment of Greater Unalaska Bay* was identified as the only study conducted prior to 2006 that discusses the impacts to surface water quality from petroleum hydrocarbons. The report stated that Iliuliuk Bay, Iliuliuk Harbor, and Dutch Harbor were impaired for petroleum products on the basis of observed oil sheens, with the expected sources being intermittent spills and illegal releases.

Stormwater

In the late 1990s, two surface water samples were collected from a stormwater outfall at Rocky Point to characterize the water quality of the discharge as part of ongoing environmental investigations. The discharge originated in the upland areas of Rocky Point, with the outfall located approximately 400 feet southeast of the Delta Western dock. Analytical data from the samples contained detectable concentrations of diesel range organics (DRO), benzene, xylenes, and PAHs, but detected concentrations were less than the State's water quality criteria (JEG 2000 as cited in OASIS 2006).

Sediments

Historical monitoring of tidal and subtidal sediments in Dutch Harbor is summarized below (OASIS 2006).

- **Unalaska Powerhouse—**Sediment residue from the Unalaska Powerhouse cooling water intake in Dutch Harbor was sampled in 1993 as a part of routine maintenance (USEPA 2000). DRO were detected in the sediment sample at 1,350 mg/kg. Sediment from the cooling water intake again was sampled in 1997, and DRO and residual range organics (RRO) both were detected.
- **U.S. Army Corps of Engineers (USACE)—**In 1996, intertidal sediments in four pits excavated near the Delta Westen Dock were observed to be visually contaminated with oil. In 1997, visual observations again were made at 13 intertidal sediment pits and at another 20 off-shore sediment locations in areas around the Delta Western Dock. Petroleum odors and sheens were observed in most locations. Additionally, five of the off-shore locations had samples collected for DRO and RRO analysis. Analytical results for DRO and RRO ranged from 102 to 615 mg/kg and 100 to 910 mg/kg, respectively (JEG 1999).
- **EPA—**Intertidal and subtidal sediment samples were collected in 1999 during an EPA investigation (USEPA 2000) in Dutch Harbor and Iliuliuk Bay. All 57 samples in Dutch Harbor

had a detectable concentration of DRO, while only one sample had an undetected concentration of RRO. The highest concentrations were centered at two areas: the area between the Delta Western Dock and the tip of Rocky Point, and the area in the center and western side of the head of Dutch Harbor behind Ballyhoo Spit. In general, the subtidal sediment samples had greater DRO and RRO concentrations than the intertidal sediment samples, likely due to the cleansing action of tides in the intertidal area and the more static environment found in the subtidal locations. Only one of the five samples along Unalaska Island had a detectable concentration of DRO, and this result was at the laboratory reporting limit (5.4 mg/kg). RRO was not detected above laboratory reporting limits in any of the samples around Unalaska Island.

4.2. Recent Investigations

ADEC conducted three monitoring studies in the study area as part of its ongoing effort to characterize water quality, assess existing impairments, and develop TMDLs for petroleum impairments. The following monitoring studies conducted include:

- **April 2007**—The baseline water quality assessment of Dutch Harbor, Iliuliuk Bay, and Iliuliuk Harbor in April 2007 included the collection of 71 water samples at 39 locations, collection of discrete sediment samples at ten locations, and collection of multi-incremental composite sediment samples within five general regions. The assessment focused on the three areas identified as having the greatest risk of impairment during the 2006 assessment (OASIS 2006). The assessment also included field observations of personal harvest activities and potential sources of petroleum pollution within the project's study area. The summary of results of the April 2007 assessment was included in OASIS (2007).
- **September 2007**—In September 2007, a second assessment of Dutch Harbor, Iliuliuk Bay, and Iliuliuk Harbor was conducted as a follow up to the April 2007 study to test for data trends, seasonal effects and to further refine the areas of impairment. The assessment included 36 water samples and 51 sediment samples collected at discrete locations within priority areas previously identified. Like the April 2007 study, the assessment also included field observations focused on potential sources of petroleum in the study area. The summary of results of the September 2007 assessment was included in OASIS (2008).
- **September 2008**—A final assessment for the study area was performed in September 2008 to examine water quality in Margaret Bay, further refine understanding of sediment pollutant concentrations in the impairment priority areas, evaluate the contributions of stormwater, and assess potential deleterious effects to aquatic life resulting from sediment contamination. The assessment included collection of four surface water samples, composited stormwater samples from three locations, 47 surface sediment samples, 11 sediment gravity core samples, and three bulk sediment samples for bioassay analysis. The summary of results of the September 2008 assessment was included in OASIS (2009).

Sediment and water samples were analyzed for BTEX and PAHs. BTEX are volatile organic compounds, which easily vaporize due to their relatively low molecular weight and high vapor pressure. BTEX are naturally found in gasoline and diesel fuel. PAHs are naturally found in fossil fuels, but are also a byproduct of incomplete combustion of carbon-containing fuels. PAHs are also typical components of oils, greases, and asphalt. Lighter PAHs (containing 2-3 benzene rings) are more water soluble than heavier PAHs (3 or more rings), which are more likely to accumulate in sediments.

To compare analytical results to applicable water quality criteria and sediment screening levels, the concentrations of BTEX constituents were summed, giving TAH. The sum of TAH and PAH represents TAqH.

The monitoring studies also analyzed the TOC content of the sediments. Hydrophobic pollutants tend to be attracted and bind to organic carbon, so statistical analysis was performed to determine whether TOC content concentrations were affecting the distribution of petroleum pollutant concentrations in the study area sediments.

Consistent analytical methods were used throughout the studies making the results directly comparable. A summary of the locations and results of the monitoring studies is presented in the following sections. Further details and complete datasets can be found in the respective reports available from ADEC (OASIS 2007, 2008 and 2009).

Surface Water Monitoring

Surface water samples were collected in all three assessment studies in 2007 and 2008. During the two 2007 assessments, surface water samples were collected from a number of locations throughout Dutch Harbor, Iliuliuk Bay, and Iliuliuk Harbor and were analyzed for BTEX and PAHs. Water sampling conducted as part of the 2008 assessment included water samples collected at four discrete locations in Margaret Bay and sampling of three stormwater outfalls. Surface water samples were analyzed for BTEX, while the stormwater samples were analyzed for PAHs.

Surface Water Locations

Surface water samples were collected at a total of 58 locations over the three assessments throughout Dutch Harbor, Iliuliuk Harbor, Iliuliuk Bay and Margaret Bay. Water samples collected as part of the April 2007 assessment were focused on near-shore areas, defined as 100 feet or less from shore, in areas of potential sources. Of the 39 sampling locations in April 2007, 26 sites were near-shore in the priority impairment areas. These included 13 sites near Rocky Point, 9 in Iliuliuk Harbor, and 4 in northern Dutch Harbor. Another seven near-shore sites were located close to other potential sources of petroleum. The remaining sites included six open-water locations, including a site in Iliuliuk Harbor. For most monitoring locations, two water samples were collected at each location: one sample at a shallow depth (1 meter below water surface) and the other at the bottom of the waterbody or five meters below water surface, whichever was less (OASIS 2007).

In the September 2007 assessment water samples were collected at 36 locations, 20 of which were sampled as part of the previous study. A single water sample was collected at each location from a depth of one meter or the bottom of the waterbody, whichever was less. The distribution of the stations focused on areas identified as having the potential for water quality impairment based on results of the April 2007 sampling. Of the 36 locations, 27 were located in the following focus areas:

- Former Submarine Base/Ship Repair Facility (2 locations)
- Small Boat Harbor (4 locations)
- UniSea (4 locations)
- Front Beach/City of Unalaska (5 locations)
- Coastal Transportation Dock (4 locations)
- Tip of Rocky Point (4 locations)
- Northern Dutch Harbor (4 locations)

As part of the September 2008 assessment, surface water samples were collected at four locations in Margaret Bay, one of which was also sampled in April 2007. A single water sample was collected at each location from a depth of one meter (OASIS 2009).

Figure 4-1 presents the stations located in Iliuliuk Harbor, Margaret Bay, and southern Iliuliuk Bay and Figure 4-2 presents the locations of stations in Dutch Harbor, northern Iliuliuk Bay, and near Rocky Point. The Appendix lists the sampling locations and sampling dates of stations monitored as part of the three ADEC assessments.

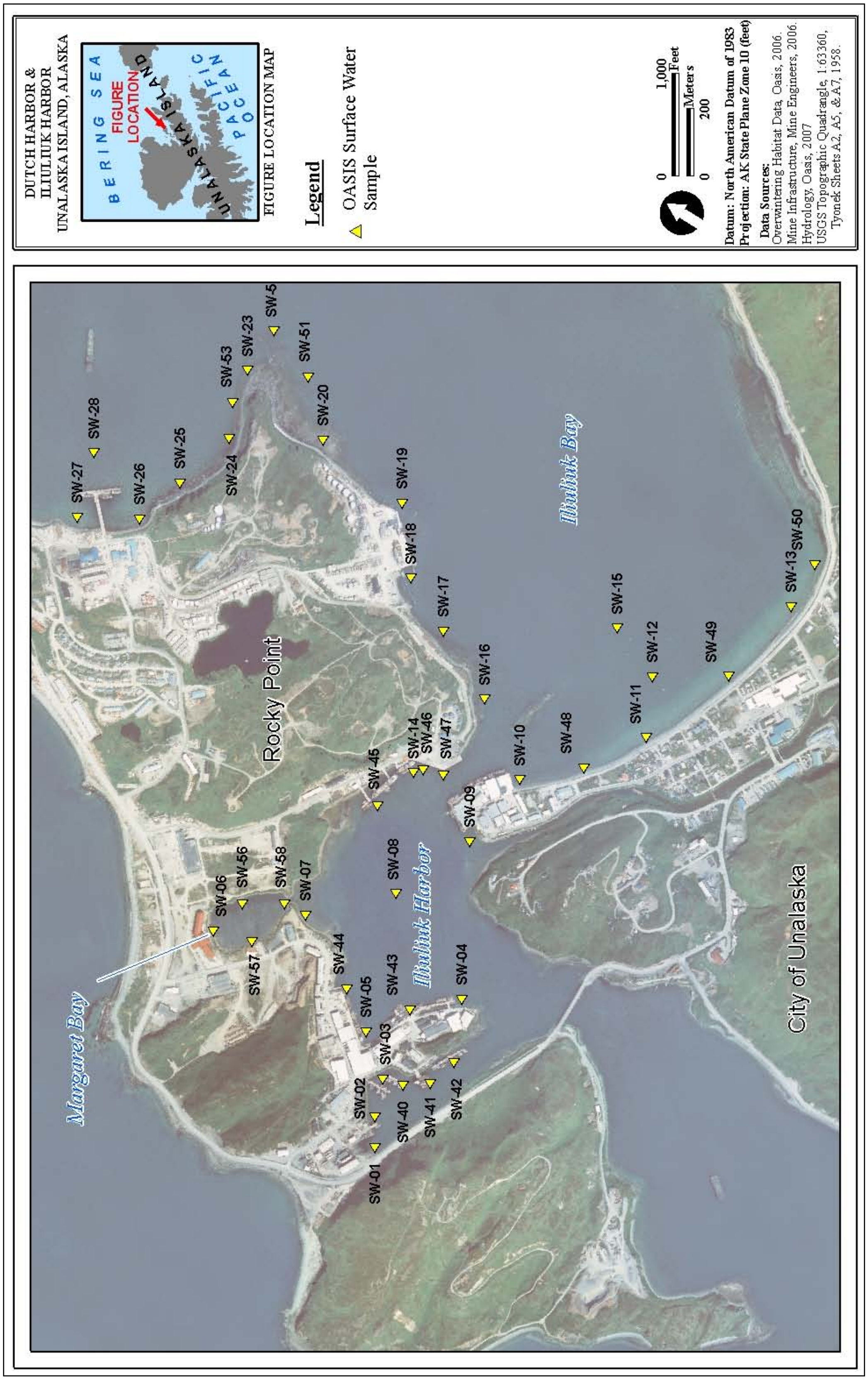

Figure 4-1. Surface water quality monitoring stations located in Iliuliuk Harbor, Margaret Bay, and southern Iliuliuk Bay (OASIS 2007, 2008,)

Figure 4-2. Surface water quality monitoring stations located in Dutch Harbor, northern Iliuliuk Bay, and near Rocky Point (OASIS 2007, 2008,)

Surface Water Results

The waters of Dutch Harbor, Iliuliuk Bay, and Iliuliuk Harbor met numeric water quality criteria for TAHs (10 µg/L) and total aqueous hydrocarbon (TAqH) (15 µg/L) in all 111 water samples collected over the three assessments (OASIS 2007, 2008, and 2009). Only 21 of the 111 samples had detectable concentrations of BTEX (TAH) or PAHs compounds and only one station (SD-02) had detectable concentrations during more than one assessment period. These detectable concentrations were well below the state water quality criteria. Because no station recorded concentrations of both TAHs and PAHs during the same sampling event, the TAqHs concentrations are equal to either the individual TAHs or PAHs concentration, whichever was detected. Table 4-1 presents the water quality monitoring results for stations where concentrations of pollutants were detected. Figure 4-3 presents the same results averaged where samples were collected at multiple depths.

Table 4-1. ADEC assessment surface water quality results for samples with detectable concentrations

Location	Station	Sample Depth (m)	TAH (µg/L)		PAH (µg/L)		TAqH (µg/L)		
			Apr 07	Sept 08	Apr 07	Sept 07	Apr 07	Sept 07	Sept 08
Iliuliuk Bay-City of Unalaska	SW-10	1.0	1.5				1.5		
	SW-11	1.0	4.53				4.53		
	SW-13	1.0	2.88				2.88		
	SW-48	1.0				0.601		0.601	
Iliuliuk Harbor	SW-01	1.0	1.04				1.04		
		2.5	0.223				0.223		
	SW-02	1.0	2.45			0.124	2.45	0.124	
	SW-03	3.0	0.253				0.253		
	SW-08	5.0			2.18		2.18		
	SW-14	1.0			3.56		3.56		
	SW-43	1.0				0.404		0.404	
	SW-44	1.0				0.283		0.283	
Dutch Harbor	SW-35	5.0			0.15		0.15		
Margaret Bay	SW-06	1.0		0.201					0.201
	SW-56	1.0		0.189					0.189
	SW-57	1.0		0.321					0.321
	SW-58	1.0		0.223					0.223
Rocky Point	SW-23	1.0	4.92				4.92		
		2.5	0.65				0.65		
	SW-29	1.0	1.69				1.69		

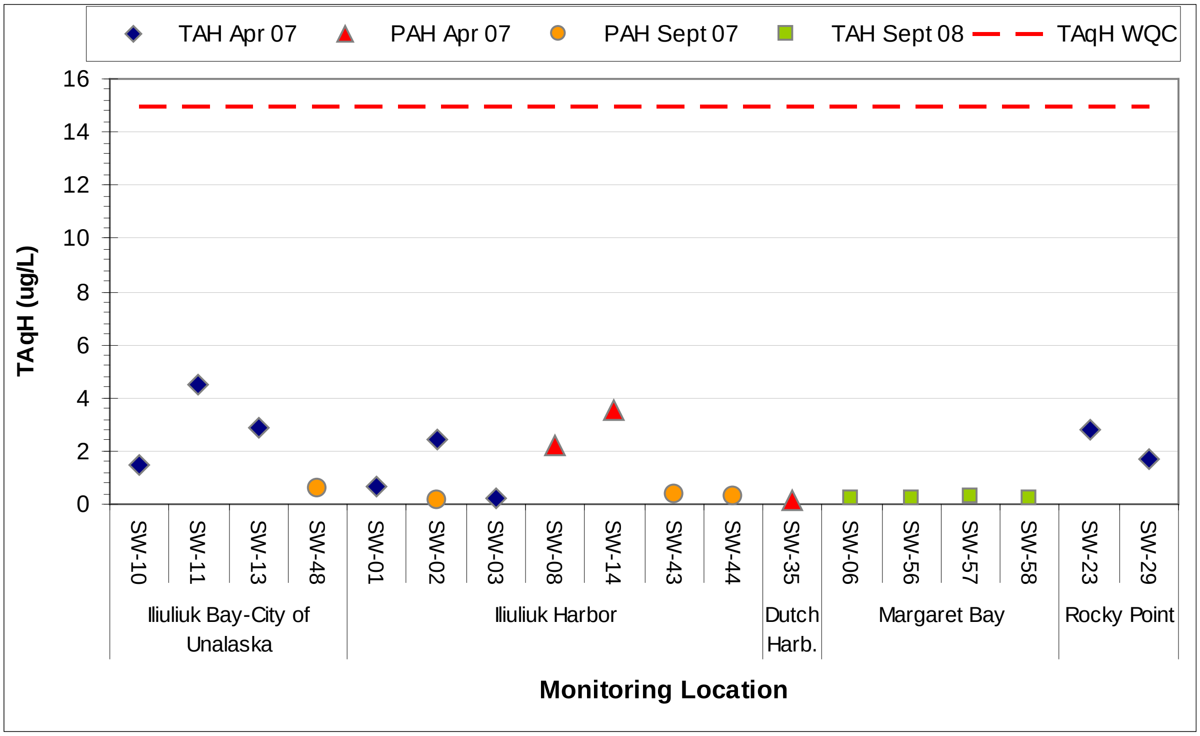

Figure 4-3. ADEC assessment surface water quality results for samples with detectable concentrations

In April 2007, concentrations of TAHs were detected in 10 of the 71 samples, corresponding to 8 of the 39 locations. The maximum concentration was 4.92 µg/L, collected at station SW-23 off the coast of Rocky Point. The portion of Iliuliuk Harbor near the small boat harbor had the greatest density of TAHs detections, with three locations (SW-01, SW-02, and SW-03) and four samples having detectable concentrations (OASIS 2007). None of the 36 water samples collected in September 2007 had a detectable concentration of TAHs (OASIS 2008). Each of the four surface water samples collected in Margaret Bay in September 2008 had TAH levels well below the water quality criteria. Concentrations were based on estimated concentrations for benzene. No other petroleum hydrocarbons were above detectable levels in the 2008 samples (OASIS 2009).

Three and four surface water samples collected in April and September 2007, respectively, had detectable concentrations of PAHs. All of the samples collected in September 2007 had PAH concentrations less than 1 µg/L. Concentrations in samples collected in April were all less than 4 µg/L with the maximum concentration (3.56 µg/L) recorded at station SW-14 in Iliuliuk Harbor (OASIS 2007 and 2008).

Stormwater Monitoring

Stormwater samples were collected as part of the 2008 study to evaluate the potential contribution of petroleum pollutants in stormwater to impairment priority areas (OASIS 2009). Field personnel sailed the coastline of the study area to locate stormwater outfalls discharging to surface waters. A total of 25 outfalls were identified in Iliuliuk Harbor, Rocky Point, and Dutch Harbor (Figure 4-4). Based on location and access, three outfalls were selected for monitoring:

- ST-01 at the Former Submarine Base/Ship Repair Facility
- ST-03 at UniSea
- ST-22 at the northern end of Dutch Harbor

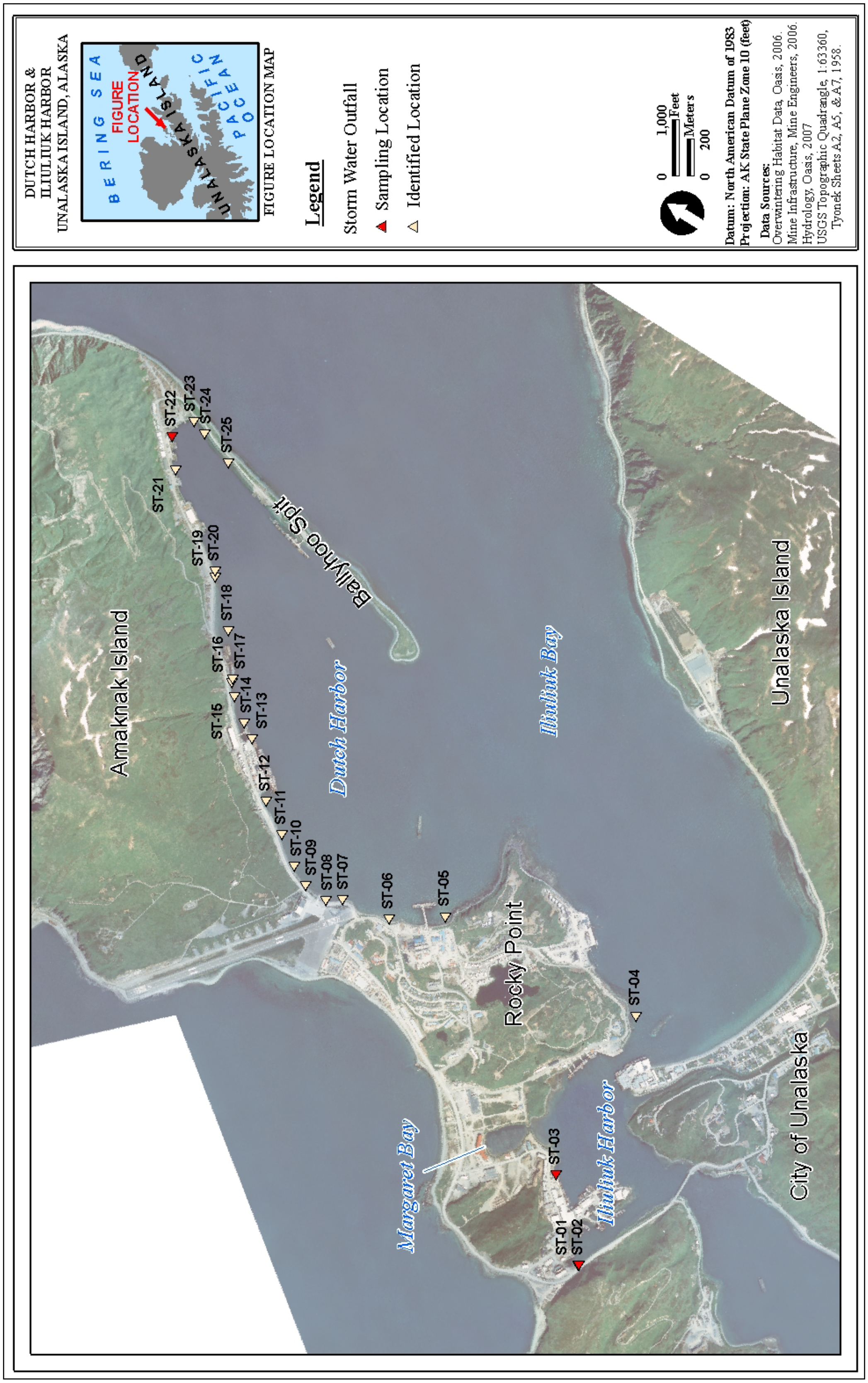

Figure 4-4. ADEC assessment stormwater outfall locations (OASIS 2009)

Composite samples were collected at each and analyzed for PAHs (Table 4-2). Because stormwater samples were not analyzed for TAHs, the TAqHs concentration is equal to the total PAH concentration. (Because the main concern regarding impairment is related to PAHs in sediment, stormwater discharge was analyzed for PAHs. Stormwater was not analyzed for BTEX because concentrations measured during previous sampling had been non-detect or below water quality criteria.)

Table 4-2. ADEC assessment stormwater outfall sampling results

Pollutant	Units	Sample Location		
		ST-1	ST-3	ST-22
Naphthalene	µg/L	ND	0.0371	0.0796
Acenaphthylene	µg/L	ND	ND	0.0474
Acenaphthene	µg/L	ND	ND	0.157
Fluorene	µg/L	ND	ND	0.238
Phenanthrene	µg/L	0.0185	ND	0.413
Anthracene	µg/L	ND	ND	0.534
Fluoranthene	µg/L	0.0405	0.022	1.48
Pyrene	µg/L	0.0409	0.0262	1.68
Benzo(a)anthracene	µg/L	ND	ND	0.330
Chrysene	µg/L	ND	ND	0.459
Benzo(b)fluoranthene	µg/L	ND	ND	0.247
Benzo(k)fluoranthene	µg/L	ND	ND	0.0832
Benzo(a)pyrene	µg/L	ND	ND	0.0817
Indeno(1,2,3-c,d)pyrene	µg/L	ND	ND	0.118
Benzo(g,h,i)perylene	µg/L	ND	ND	0.04847
TAqH	**µg/L**	**0.0999**	**0.0853**	**6.00**

Outfall ST-1 at the former submarine base in Iliuliuk Harbor had estimated concentrations of phenanthrene, fluoranthene, and pyrene, and outfall ST-3 at UniSea had estimated concentrations of naphthalene, fluoranthene, and pyrene. The resulting TAqH concentrations for ST-1 and ST-3 were both less than 0.1 µg/L, significantly less than the water quality criteria of 15 µg/L. The analytical result for ST-22 in northern Dutch Harbor had detectable concentrations for most PAHs. The resulting TAqH concentration for ST-22 was 6.00 µg/L (OASIS 2009).

Sediment Monitoring

Various types of sediment samples were collected as part of the three ADEC assessments of the Dutch Harbor study area. The April 2007 assessment was designed to evaluate baseline sediment quality at locations corresponding to near-shore water sample locations or potential sources of petroleum pollution (discussed in Section 5). It included the collection of ten discrete sediment samples and five composite sediment samples from five grid regions in the study area. All sediment samples were analyzed for BTEX, PAHs, and TOC.

Fifty-one sediment samples were collected during the September 2007 assessment to further investigate areas that had elevated pollutant concentrations of PAHs in the April 2007. Samples were again analyzed for BTEX, PAHs, and TOC.

As part of the 2008 assessment multiple types of sediment samples were collected within Dutch Harbor and Iliuliuk Harbor to further investigate the level of petroleum contamination and the potential impacts to benthic aquatic life. Sediment monitoring included 47 surface sediment samples, 11 core sediment samples, and 3 bulk sediment samples. Surface and core samples were analyzed for PAHs and TOC, while the bulk sediment samples were used to conduct bioassay tests for chronic and acute toxicity.

Surface Sediment Locations

Sediment samples were collected at a total of 90 locations over the three assessments. The April 2007 assessment included the collection of 15 subtidal sediment samples, collected 100 feet or less from shore. Five of the samples (SD-11 – SD-15) were collected within grid regions using a multi-incremental sampling technique, with a single composite sample for each of the five grids created using sediment collected at nine random polygons within the grid. The remaining 10 samples were discrete grab samples collected within areas of potential impairment (OASIS 2007).

Sediment sampling done as part of the September 2007 assessment included 51 discrete subtidal sediment samples, eight of which were sampled in April (OASIS 2008). The sample locations were selected to increase sample density near areas that had elevated concentrations of PAHs in the April 2007 assessment, including:

- Iliuliuk Harbor – Potential sources are the former Submarine Base/Ship Repair Facility, the former Fort Mears Gasoline Station, Alyeska Seafoods, UniSea, and the small boat harbor.
- Rocky Point – Potential sources are the Lower Tank Farm, the former Tank 17/18 Area, and the APL Dock.
- Delta Western Dock – Potential sources are the former Upper Tank Farm, the pre-World War II Tank Farm, and the former Aqua Fuel System #1.
- Unalaska Marine Center (UMC) / U.S. Coast Guard Dock – Potential sources include the North Pacific Fuel – Ballyhoo Road facility.
- Ballyhoo Spit – Potential source is the public light cargo dock.
- Northern Dutch Harbor – Potential upland and coastal sources are the former Mount Ballyhoo Spit Tank Farm, the North Pacific Fuel Resoff Terminal, and Icicle Seafoods.

The September 2008 assessment included multiple sediment sample types as mentioned above. Forty-seven discrete surface sediment samples were collected in the priority impairment areas in the vicinity of potential pollution sources, including the former Submarine Base/Ship Repair Facility, the small boat harbor, UniSea, Alyeska Seafoods, Delta Western, and the head of Dutch Harbor. In addition, four sediment samples were collected from Margaret Bay at locations that corresponded to surface water samples to determine if sediments in Margaret Bay have been affected by petroleum pollutants (OASIS 2009).

September 2008 discrete sediment monitoring included four locations sampled as part of both the April and September 2007 studies and 11 locations sampled only in September 2007. The eleven core sediment samples collected in conjunction with the discrete samples were located in the vicinity of potential sources including the small boat harbor, Delta Western Dock, and northern Dutch Harbor. Bulk sediment samples were collected near the small boat harbor, the light cargo dock, and at the mouth of Dutch Harbor. Figure 4-5 and Figure 4-6 present the locations of discrete grab, core, and bulk sediment samples; Figure 4-7 presents the locations of the multi-incremental composite samples. The Appendix lists the sediment sampling locations and sample types for each assessment.

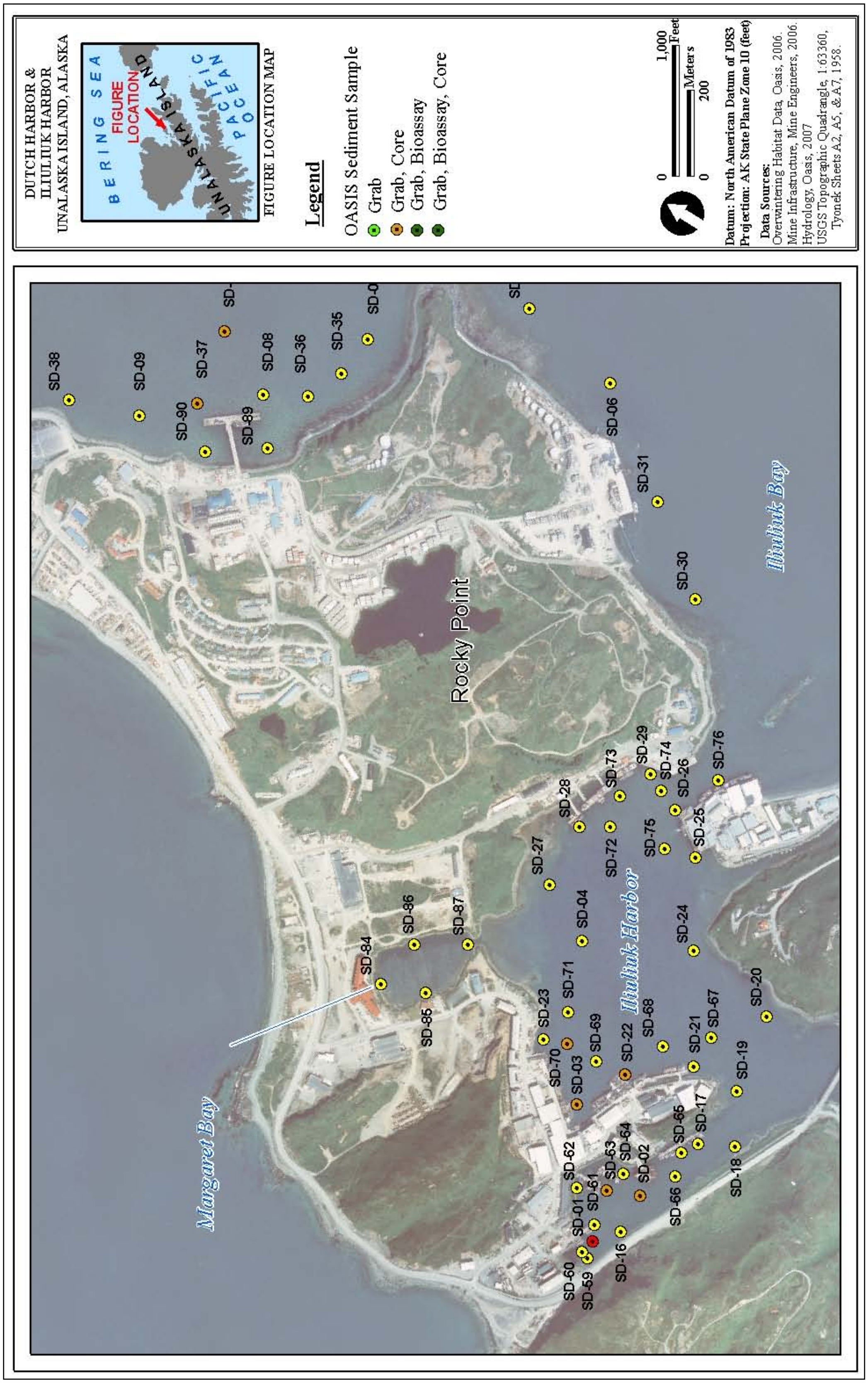

Figure 4-5. Discrete sediment quality monitoring stations located in Iliuliuk Harbor, Margaret Bay, and southern Iliuliuk Bay (OASIS 2007, 2008, 2009)

Figure 4-6. Discrete sediment quality monitoring stations located in Dutch Harbor and near Rocky Point (OASIS 2007, 2008, 2009)

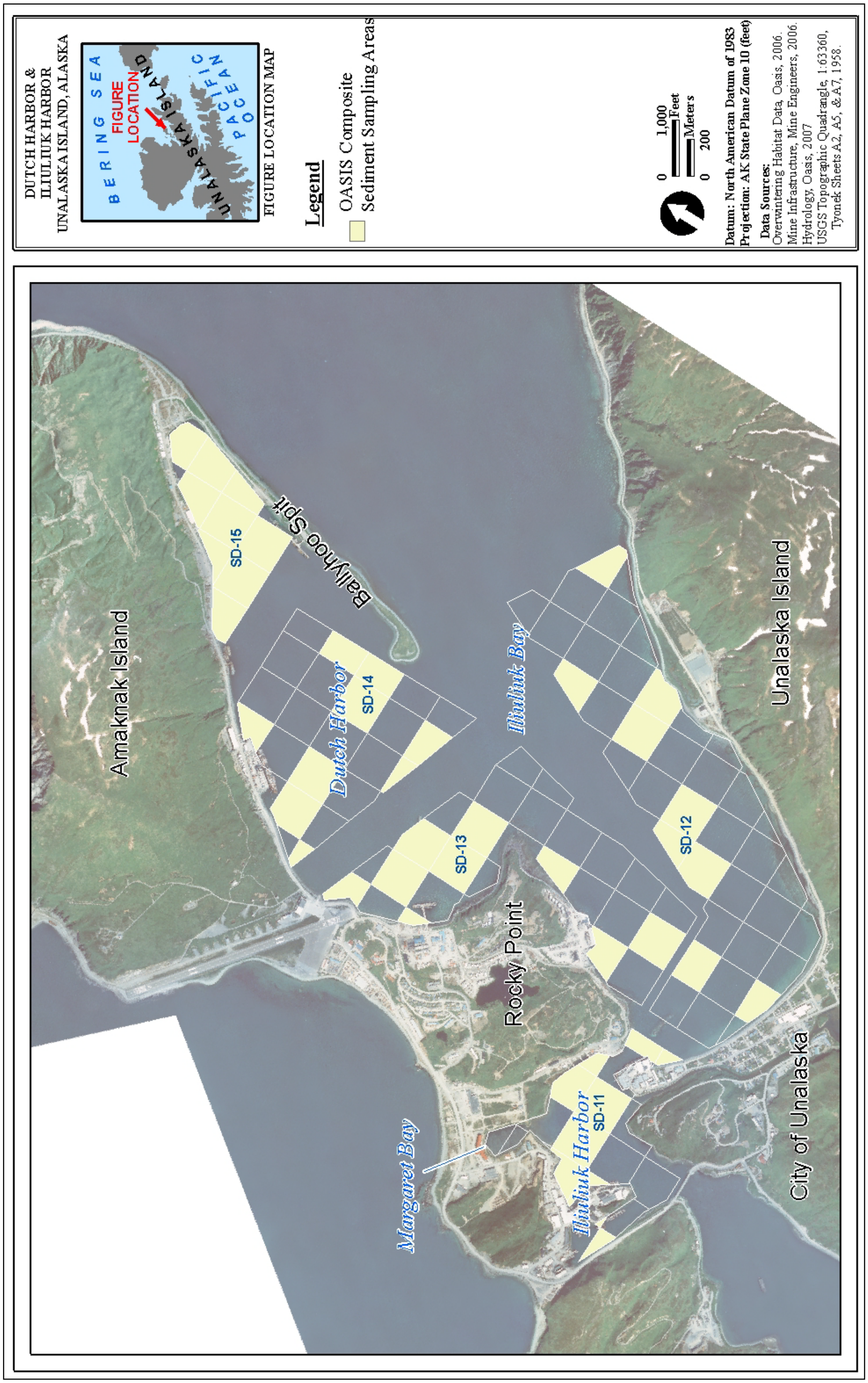

Figure 4-7. Sediment quality multi-incremental sampling locations (OASIS 2007)

Surface Sediment Results

Data from the three assessments indicate that the most impacted areas are in Iliuliuk Harbor, and along the industrial shoreline of northern Dutch Harbor, with contamination concentrated near active docks and harbors. These two regions likely are the busiest areas for boat moorings and maintenance and have less movement of water than other water bodies in the study area. The assessments also suggest that certain areas have sediment PAH concentrations consistently less than the TEL benchmark for total PAHs. These areas include the portion of Dutch Harbor from approximately Magone's Marine to the eastern end of the airport runway; Iliuliuk Bay, including most of Rocky Point (except the area around the Delta Western Dock); the open water area of Iliuliuk Harbor; and the southeastern portion of Iliuliuk Harbor (except the area near Unisea) (OASIS 2007, 2008, and 2009).

The region on the east side of Iliuliuk Bay has the lowest concentration of total PAHs, which is likely due to the low levels of boat traffic in the area and the significant wave and tidal effects from the Bering Sea to the north.

Table 4-3 presents sediment quality monitoring results for TAHs and PAHs for the three assessments. Values that exceeded the total PAH TEL screening level (1,684.06 µg/kg) are in bold, while values that exceeded the PEL (16,770.4 µg/kg) are bold and underlined. Figure 4-8, Figure 4-9 and Figure 4-10 compare the sediment total PAH results to the applicable TEL and PEL sediment quality screening levels. Note that the figures present the range of data at stations where multiple samples were collected and monitoring results given in Figure 4-9 are presented on a log scale to account for the large spread in the data collected in Iliuliuk Harbor.

Table 4-3. ADEC assessment sediment quality results

		April 07		Sept 07		Sept 08	
		Grab		Grab		Grab	Gravity core
Sample Location	Location	TAHs (µg/kg)	PAHs (µg/kg)	TAHs (µg/kg)	PAHs (µg/kg)	PAHs (µg/kg)	
SD-05	Dutch Harbor	ND	290				
SD-10	Dutch Harbor	57.8	**6,082**	ND	**9,221**		
SD-14	Dutch Harbor	ND	244				
SD-15	Dutch Harbor	ND	1,277				
SD-39	Dutch Harbor			ND	649		
SD-40	Dutch Harbor			ND	1,240		
SD-41	Dutch Harbor			ND	677		
SD-42	Dutch Harbor			ND	1,642		
SD-43	Dutch Harbor			ND	72		
SD-44	Dutch Harbor			ND	1,546		
SD-45	Dutch Harbor			ND	**1,759**	**1,766**	
SD-46	Dutch Harbor			ND	**6,586**	**1,792**	
SD-47	Dutch Harbor			ND	**4,883**		
SD-48	Dutch Harbor			ND	638		
SD-49	Dutch Harbor			ND	**7,375**		
SD-50	Dutch Harbor			ND	**8,596**	**5,402**	970
SD-51	Dutch Harbor			ND	**6,079**		
SD-52	Dutch Harbor			ND	**5,993**		

Sample Location	Location	April 07 Grab TAHs (µg/kg)	April 07 Grab PAHs (µg/kg)	Sept 07 Grab TAHs (µg/kg)	Sept 07 Grab PAHs (µg/kg)	Sept 08 Grab PAHs (µg/kg)	Sept 08 Gravity core PAHs (µg/kg)
SD-53	Dutch Harbor			ND	**8,472**	**8,696**	1329
SD-54	Dutch Harbor			ND	1,542		
SD-55	Dutch Harbor			ND	514		
SD-56	Dutch Harbor			ND	**14,560**	145	
SD-57	Dutch Harbor			ND	**2,148**		
SD-58	Dutch Harbor			ND	358		
SD-78	Dutch Harbor					251	
SD-79	Dutch Harbor					919	NQ
SD-80	Dutch Harbor					1,140	
SD-81	Dutch Harbor					1,173	
SD-82	Dutch Harbor					**2,017**	
SD-83	Dutch Harbor					**2,490**	
SD-88	Dutch Harbor					129	
SD-12	Iliuliuk Bay	34.9	214				
SD-01	Iliuliuk Harbor	83.3	<u>**24,911**</u>	ND	<u>**112,840**</u>	**8,588**	752
SD-02	Iliuliuk Harbor	ND	**4,502**	ND	**4,036**	**5,210**	NQ
SD-03	Iliuliuk Harbor	ND	**13,061**	ND	<u>**94,455**</u>	**8,022**	**5615**
SD-04	Iliuliuk Harbor	52.7	902	ND	1,675		
SD-11	Iliuliuk Harbor	136.9	1,396				
SD-16	Iliuliuk Harbor			ND	**3,644**		
SD-17	Iliuliuk Harbor			ND	567		
SD-18	Iliuliuk Harbor			ND	486		
SD-19	Iliuliuk Harbor			ND	371		
SD-20	Iliuliuk Harbor			ND	890		
SD-21	Iliuliuk Harbor			ND	**2,617**	324	
SD-22	Iliuliuk Harbor			ND	<u>**18,826**</u>	**6,438**	830
SD-23	Iliuliuk Harbor			ND	**13,418**	**16,605**	
SD-24	Iliuliuk Harbor			ND	325		
SD-25	Iliuliuk Harbor			ND	700		
SD-26	Iliuliuk Harbor			ND	<u>**32,495**</u>	1,502	
SD-27	Iliuliuk Harbor			ND	627		
SD-28	Iliuliuk Harbor			ND	**1,937**	**1,995**	
SD-29	Iliuliuk Harbor			ND	332		
SD-59	Iliuliuk Harbor					**2,673**	
SD-60	Iliuliuk Harbor					<u>**22,700**</u>	
SD-61	Iliuliuk Harbor					**4,442**	
SD-62	Iliuliuk Harbor					**5,154**	
SD-63	Iliuliuk Harbor					**4,650**	65
SD-64	Iliuliuk Harbor					**3,060**	

		April 07		**Sept 07**		**Sept 08**	
		Grab		**Grab**		**Grab**	**Gravity core**
Sample Location	**Location**	**TAHs (µg/kg)**	**PAHs (µg/kg)**	**TAHs (µg/kg)**	**PAHs (µg/kg)**	**PAHs (µg/kg)**	
SD-65	Iliuliuk Harbor					617	
SD-66	Iliuliuk Harbor					**2,053**	
SD-67	Iliuliuk Harbor					735	
SD-68	Iliuliuk Harbor					**1,840**	
SD-69	Iliuliuk Harbor					1,440	
SD-70	Iliuliuk Harbor					**4,709**	139
SD-71	Iliuliuk Harbor					325	
SD-72	Iliuliuk Harbor					1,020	
SD-73	Iliuliuk Harbor					**<u>99,569</u>**	
SD-74	Iliuliuk Harbor					**4,329**	
SD-75	Iliuliuk Harbor					1,221	
SD-76	Iliuliuk Harbor					271	
SD-84	Margaret Bay					75	
SD-85	Margaret Bay					1,084	
SD-86	Margaret Bay					693	
SD-87	Margaret Bay					315	
SD-06	Rocky Point	ND	489	ND	147		
SD-07	Rocky Point	ND	148				
SD-08	Rocky Point	ND	**2,392**	ND	1,378	**1,713**	
SD-09	Rocky Point	ND	603	ND	488		
SD-13	Rocky Point	ND	425				
SD-30	Rocky Point			ND	761		
SD-31	Rocky Point			ND	417		
SD-32	Rocky Point			ND	393		
SD-33	Rocky Point			ND	NQ		
SD-34	Rocky Point			ND	390		
SD-35	Rocky Point			ND	238		
SD-36	Rocky Point			ND	916		
SD-37	Rocky Point			ND	**2,052**	**11,659**	29
SD-38	Rocky Point			ND	422		
SD-77	Rocky Point					292	304
SD-89	Rocky Point					309	
SD-90	Rocky Point					**2,190**	

ND=not detected
Note: Values that exceeded the total PAH TEL screening level of 1,684.06 µg/kg are in bold, while values that exceeded the PEL of 16,770.4 µg/kg are bold and underlined.

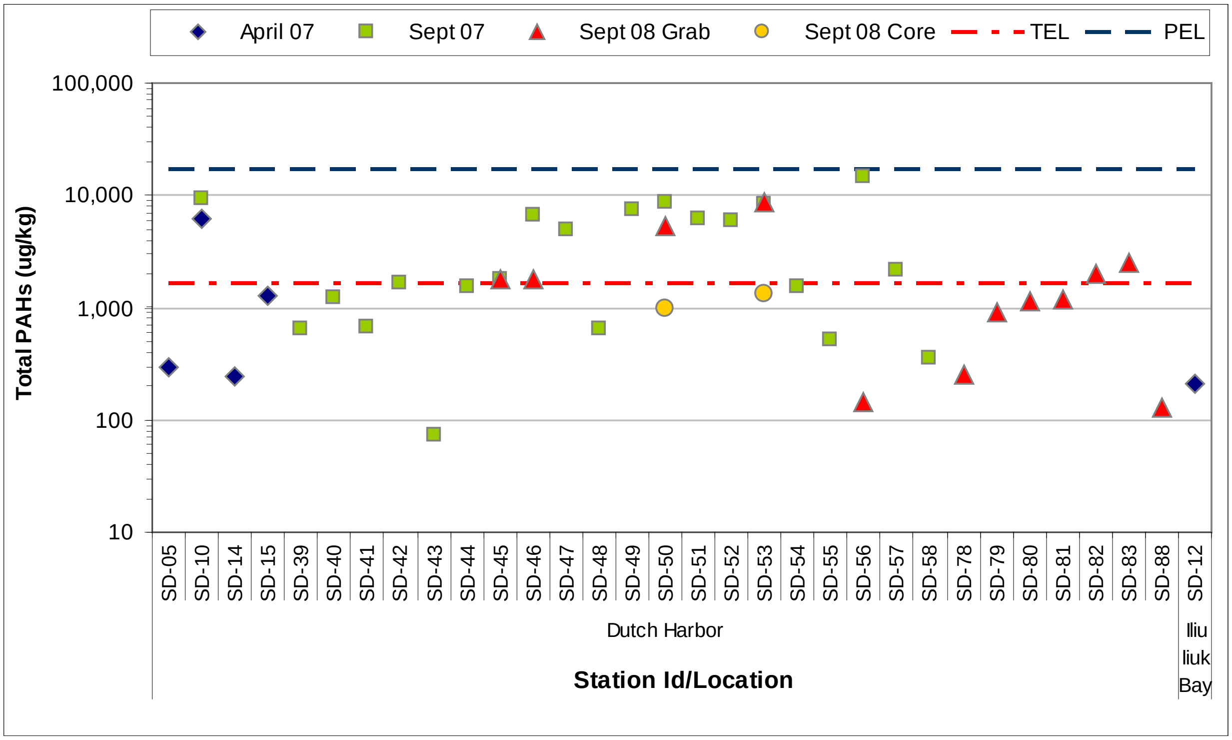

Figure 4-8. Sediment quality results for Dutch Harbor and Iliuliuk Bay

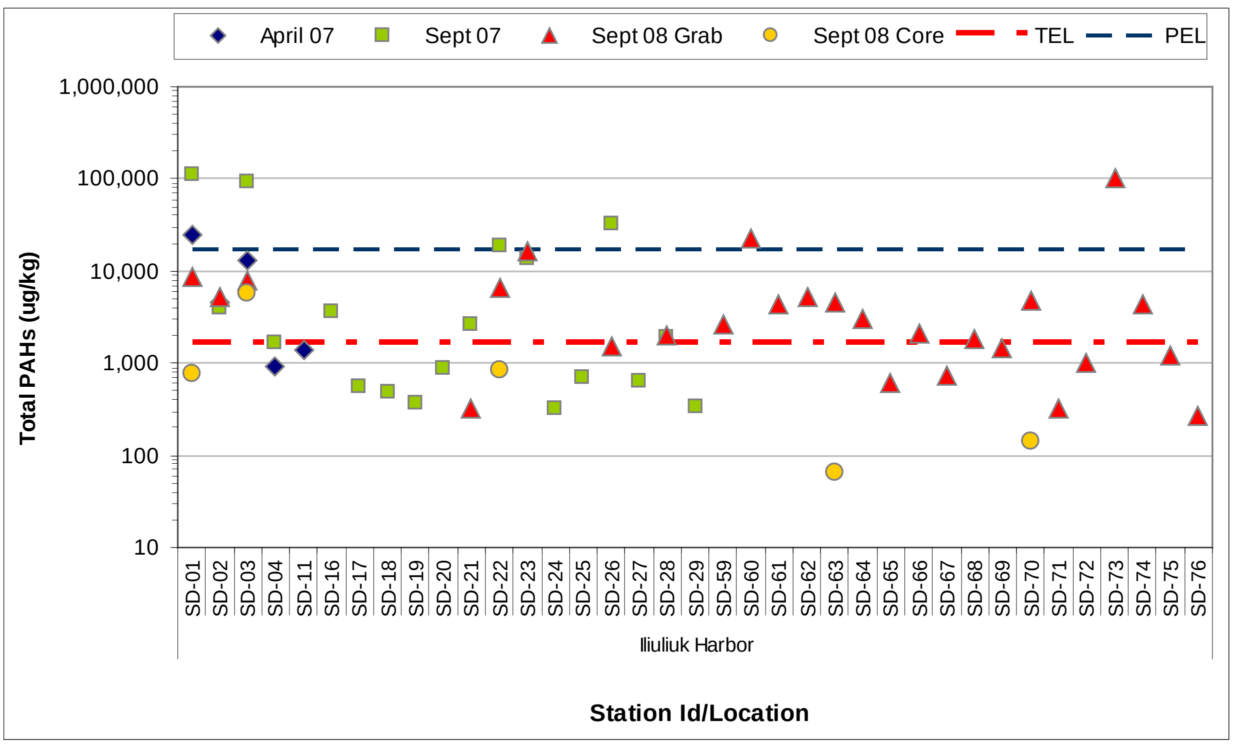

Figure 4-9. Sediment quality results for Iliuliuk Harbor on a log scale

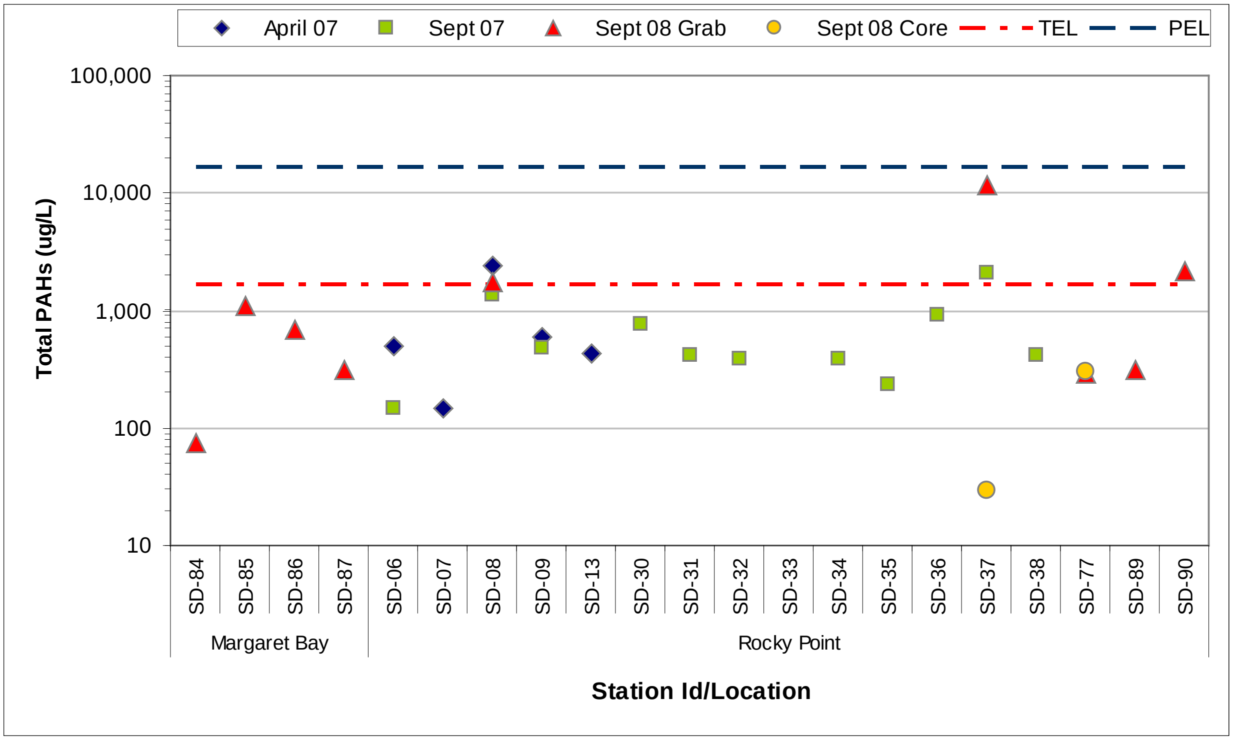

Figure 4-10. Sediment quality results for Margaret Bay and Rocky Point

All of the 15 surface sediment samples collected in April 2007, all but one (SD-33) of the 51 sediment samples collected in September 2007 and all of the 47 samples collected in September 2008 had detectable concentrations for PAH compounds. Five of the 15 samples in April 2007 had at least one BTEX compound detected; however, all the detections of BTEX (TAHs) were at estimated concentrations less than laboratory reporting limits. None of the samples collected in September 2007 had detectable concentrations of BTEX, and samples collected in September 2008 were not analyzed for BTEX (OASIS 2007, 2008, and 2009).

In April 2007, 10 of the 15 samples had at least one PAH compound that exceeded a TEL screening level for sediment quality, and 4 of the 15 samples had at least one compound that exceeded a PEL benchmark. Five samples exceeded the TEL for total PAHs, one of which (SD-01 located in Iliuliuk Harbor) also exceeded the PEL (OASIS 2007).

In September 2007, 37 of the 51 locations had at least one PAH compound that exceeded a TEL screening level for sediment quality, and 14 of the samples had at least one compound that exceeded a PEL benchmark. Almost half of the sediment samples (21 out of 51) exceeded the TEL benchmark for total PAHs. Of those, four exceeded the higher PEL benchmark for total PAHs: SD-01, SD-03, SD-22, and SD-26 in Iliuliuk Harbor (OASIS 2008).

In September 2008, PAH compounds were detected in all 47 surface sediment samples collected. The TEL screening level was exceeded for at least one PAH compound at 36 locations, and 10 of the samples had at least one compound that exceeded a PEL benchmark. In addition, samples collected at SD-60 in southwestern Iliuliuk Harbor and at SD-73 in northern Iliuliuk Harbor exceeded the PEL screening level for total PAHs. The TEL for total PAHs was also exceeded in 24 other samples (OASIS 2009).

In addition, TOC data were collected with each sediment sample taken during the April and September assessments and at select locations during the September 2008 assessment. Sediment TOC content was analyzed to account for the effects sediment TOC content may be having on petroleum hydrocarbon concentrations. Analysis results of TOC-normalized data for PAHs showed that TOC concentrations were not affecting the distribution of PAH concentrations in sediments (OASIS 2007, 2008, and 2009).

Sheens were also observed on the surface of many of the sediment samples. During September 2007, 20 of the 51 sediment samples had light sheening visible in the sample material. Five other locations had significant sheening, including locations in northern Dutch Harbor and near the former submarine base in Iliuliuk Harbor. Samples collected in September 2008 also had sheening visible in the sample material. Of the 47 surface sediment sample locations, 24 had light to moderate sheening, and the sample collected at SD-01 had significant sheening (OASIS 2008 and 2009).

Sub-surface Sediment

During the September 2008 assessment, a gravity core sampler was used to collect sediment samples at one foot below the surface at 11 locations where surface samples were also collected (Figures 4-5 and 4-6). Sediment core samples were used to investigate the relationship between surface and sub-surface sediment total PAH concentrations and to assess the depth of contamination. Table 4-5 and Figures 4-8 through 4-10 present the analytical results for sediment core samples.

The core sample from location SD-03 in Iliuliuk Harbor was the only sample that exceeded the TEL for total PAHs. Two core samples, SD-02 and SD-79, had non-detects for all PAH compounds (OASIS 2009).

OASIS (2009) included an analysis of the ratios of total PAHs in the core samples to total PAHs in the associated surface sample for those stations with detectable concentrations. Prior to evaluating the core to surface ratios for possible trends, OASIS determined that core samples collected at stations SD-77 and SD-03 should be excluded from the analysis. Monitoring results for surface and core samples at SD-77 were both well below the TEL benchmark and the location is not within an impacted area. The core surface ratio (0.7) at station SD-03 is well above the ratios observed at other locations, even in comparison to monitoring locations in its immediate vicinity (SD-22 and SD-70).

Excluding results from stations SD-77 and SD-03, the ratios ranged from 0.002 at SD-37 to 0.18 at SD-50 with a median result of 0.09. This analysis suggests that at a depth of one foot concentrations of PAHs are likely to be one-tenth of surface concentrations in the study area sediments. The analysis indicated that for most locations in the study area PAH contamination is limited to the first few inches of surface sediment, which includes the biologically active zone 4–10 centimeters below the surface. Petroleum in surface sediments, therefore, could be impacting benthic communities in the study area.

Sediment Toxicity

During the September 2008 assessment, bulk sediment was collected from three sample locations for bioassay tests of chronic and acute toxicity. Figures 4-5 and 4-6 show the sample locations. Each location was selected because of the contamination levels observed in previous studies including the following considerations:

- SD-01: had the greatest concentrations of total PAHs in the April and September 2007 assessments exceeding the PEL
- SD-45: had a concentration of total PAHs in September 2007 that was similar to the TEL action level
- SD-88: selected as a site control sample

Three separate bioassay tests were performed on each sample. The tests are based on recommended procedures as detailed in Washington State sediment standards (WAC 173-204-315). The tests included one chronic and two acute bioassays. The chronic bioassay was a 20-day growth-rate analysis of the juvenile polychaete Neanthes arenaceodentata. The acute bioassays included a 10-day mortality test on the amphipod Ampelisca abdita and a 48-hour mortality/abnormality test on the blue mussel Mytilus galloprovincialis (OASIS 2009).

Table 4-4 presents analytical results of the bioassay tests. Results indicate that for the chronic and two acute bioassays the survival, development, and growth of aquatic life were not affected at three bulk sediment sample locations. However, the limited number of samples collected (three) represent too small of a dataset to draw definitive conclusions regarding sediment toxicity (OASIS 2009). Because the distribution of sediment contamination in marine waters can be highly variable, a larger sample size is needed before definitive conclusions can be drawn about sediment toxicity.

Table 4-4. Bulk sediment bioassay toxicity results

Statistic	Unit	Sample Location		
		SD-01	SD-45	SD-88
Acute Tests				
Elutriate Bioassay for M. galloprovincialis				
Mean Survival	%	89.0	82.6	97.7
Mean Normal Development	%	95.4	93.8	94.2
Sediment Bioassay for A. abdita				
Mean Survivial	%	91	78	80
Chronic Test				
Sediment Bioassay for N. arenaceodentata				
Mean Survival	%	100	100	100
Growth	mg/d	0.617	0.547	0.657

Field Observations

During the course of the April 2007 sampling event, field personnel recorded observations related to potential sources of petroleum pollution. Thirteen stormwater outfalls were observed during water and sediment sampling, but none had visible hydrocarbon sheen. Sheens were observed, however, near UniSea, Icicle Seafoods *Bering Star* floating processor, and the light cargo dock. Discharges of non-contact cooling water from seafood processing at UniSea and Icicle Seafoods *Bering Star* floating processor were observed during field sampling. No spills were observed during sampling, but surface sheens were noticed during water sampling at SW-05 (UniSea), SW-35 (light cargo dock), and SW-39 (Icicle Seafoods *Bering Star* floating processor).

Field personnel also recorded field observations during the September 2007 sampling event. Twenty-six stormwater outfalls were observed, none with a noticeable oil sheen, however. Two seafood processors (UniSea and Icicle Seafoods *Arctic Star* floating processor) had active discharge of non-contact cooling water. Field personnel observed small sheens around these facilities during the April 2007 assessment. Oil sheens were observed in the September 2007 assessment at the APL Dock. Discharges of non-contact cooling water from seafood processing at UniSea and the Icicle Seafoods *Arctic Star* floating processor were observed during field sampling. No spills were observed during sampling, but a surface sheen was observed near the stern of a vessel that was at the APL Dock.

The observed sheens appeared to be the intermittent, small areas of sheen typically seen around vessels but are not thought to be indicative of spills or other discharges or of a persistent problem with chronic sheening.

4.3. Summary

Results from the ADEC 2007–2008 monitoring studies for the study area show that surface waters are meeting applicable water quality standards, while sediment quality, evaluated using NOAA TEL and PEL benchmarks, is not meeting water quality standards and is considered impaired. Figure 4-11 and Figure 4-12 present the range of maximum sediment PAH concentrations at monitoring locations that exceed the TEL value. In addition to the PEL and TEL levels discussed in Section 3.1, the figures also show the effects range-low (ERL) and the effects range-median (ERM) benchmarks. ERL defines a concentration below which effects are rarely observed or predicted among sensitive life stages and (or) species of biota, while ERM defines a concentration above which effects are frequently or always observed among most species of biota.

The following summarizes the findings of the sampling events conducted in April 2007, September 2007 and September 2008 in the study area:

- A total of 111 water samples were collected as part of the three assessments throughout Dutch Harbor, Iliuliuk Bay, Iliuliuk Harbor and Margaret Bay. Only 16 of the 107 samples had a detectable concentration of BTEX or PAH compounds, and none of the samples had concentrations in exceedance of numeric water quality criteria for TAH or TAqH.
- The cumulative set of surface sediment data for all three assessments demonstrates that sediment contamination is limited to the priority areas of impairment, including the areas surrounding the Former Submarine Base/Ship Repair Facility, Small Boat Harbor, UniSea, Alyeska Seafoods (including the Coastal Transportation dock), Delta Western dock, and the northern end of Dutch Harbor. In addition, the cumulative data indicate that the impacted sediments generally are located near the docks within the impaired areas.
- The results of the sediment core samples show that impact from PAHs generally appears to be limited to the sediment surface. At all but one station, concentrations of PAHs showed a marked decrease at a depth of one foot into the sediment horizon. That contamination seems to be restricted to the sediment surface layer suggests either contamination is the result of recent spill activity or sedimentation within the study area occurs slowly.
- Stormwater data from outfall stations ST-01 and ST-03 in the southern portion of Iliuliuk Harbor indicate that stormwater is not likely a significant contributing factor to sediment contamination in the Iliuliuk Harbor impacted areas. Stormwater from outfall ST-22, located at the northern end of Dutch Harbor, may be influencing sediment contamination in the Dutch Harbor impacted and impaired areas: however, the source of the PAHs in the stormwater from outfall ST-22 is unknown at this time.
- The data indicate that the carbon content of the sediment has negligible effect on concentrations of PAHs.
- All three bioassay tests showed no reduction in survival, development, or growth for the three forms of aquatic life tested: mussel, amphipod, and polychaete. The tests compared results for sample locations SD-01 and SD-45 to both the site control sample at SD-88 and laboratory control samples. Because the distribution of sediment contamination in marine waters can be highly variable, the limited number of samples collected represents too small a dataset to draw definitive conclusions regarding sediment toxicity.

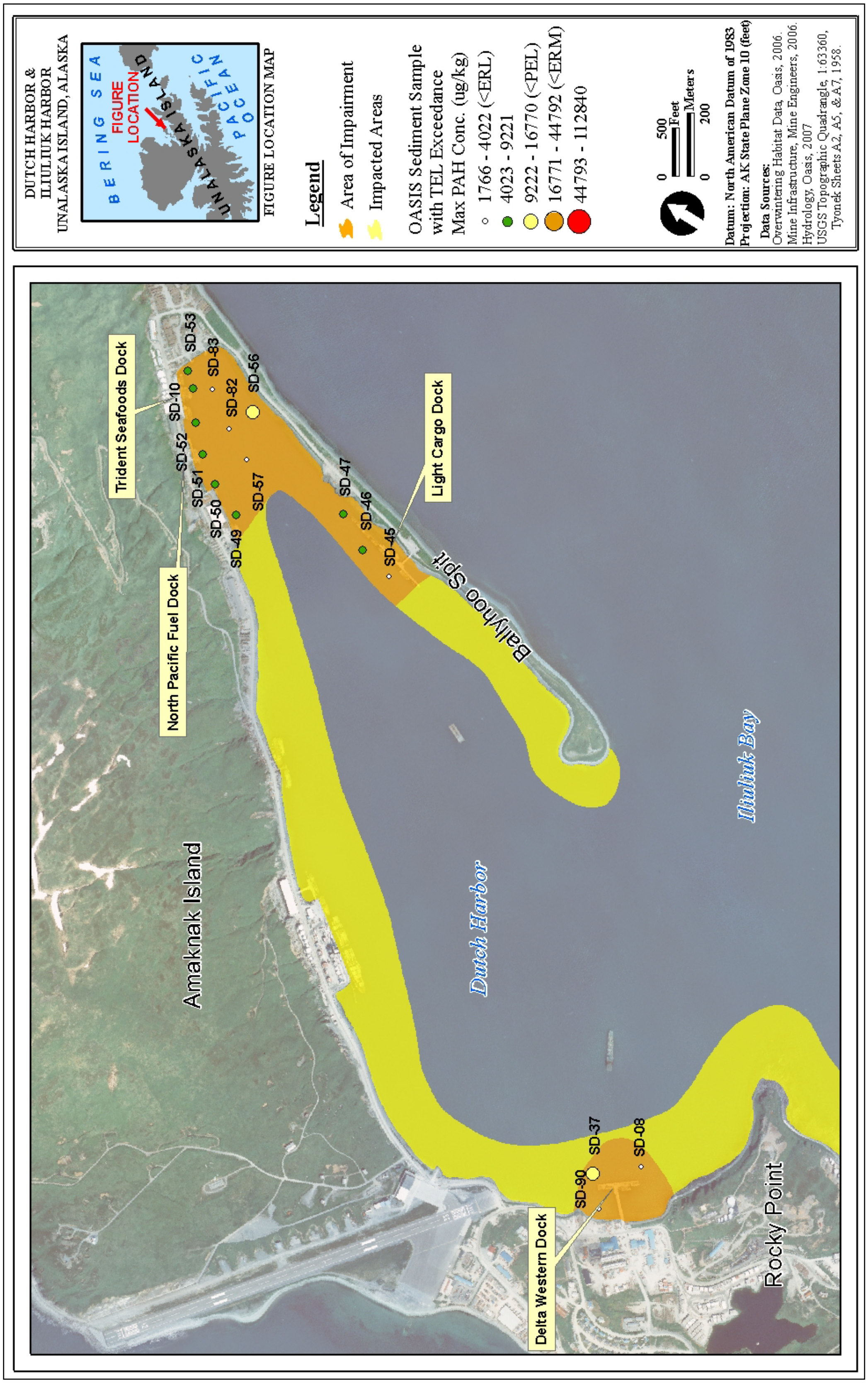

Figure 4-11. Sediment monitoring locations in Dutch Harbor with TEL exceedances

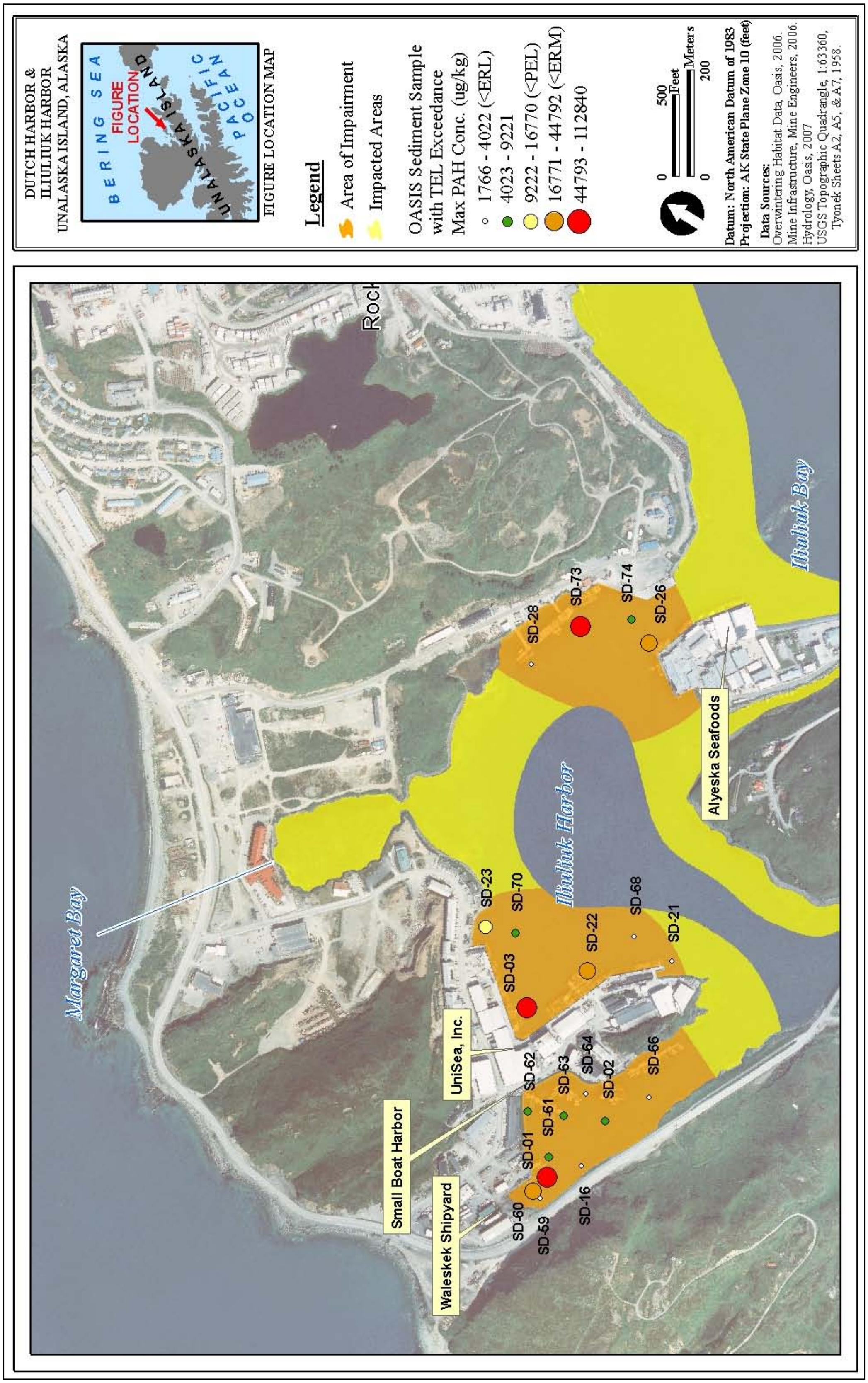

Figure 4-12. Sediment monitoring locations in Iliuliuk Harbor with TEL exceedances

5. Potential Sources of Petroleum Pollution

In June 2006 ADEC completed a review of existing data and information to identify potential sources of petroleum pollution in the study area that might be contributing to violations of the petroleum hydrocarbon water quality criteria (OASIS 2006). This review informed the monitoring studies conducted in 2007–2008. In general, sources can be grouped into the following categories:

- On-shore contaminated sites
- Marine and onshore spills
- Stormwater runoff
- Harbor and vessel activities (seafood processors, petroleum storage and transfer facilities, and docks and harbors)
- Creosote-treated wood pilings at docks and harbors

The following subsections summarize the information provided in the 2006 ADEC study about these existing and potential sources of petroleum; further details can be found in the study report (OASIS 2006).

While sources described in this section are likely contributors to the petroleum impairment in Dutch Harbor and Iliuliuk Harbor, data are not available to quantify their petroleum inputs or establish a direct link between their inputs and impairment. Therefore, the TMDL will not likely calculate individual allocations for these sources. Instead, the information on sources and their likely contribution to impairment will be used to identify and target management strategies to reduce petroleum inputs and restore water quality standards.

5.1. Contaminated Sites

The greater Unalaska area has several contaminated sites that are impacted with petroleum-related pollutants. ADEC's Division of Spill Prevention and Response, Contaminated Sites Program is responsible for managing cleanup operations at contaminated sites in the state. This program uses two databases to track contaminated sites: Contaminated Sites and Leaking Underground Storage Tanks (LUST). A review of the Contaminated Sites and LUST databases as part of the ADEC 2006 study identified eight contaminated sites in the "Unalaska" or "Dutch Harbor" search areas that were characterized as having more than a minimal potential to affect water quality. The sites range from ones impacted by a single underground storage tank (UST) to bulk fuel farms with releases of up to one million gallons of petroleum fuels. Table 5-1 presents descriptions of these sites, and the site locations are depicted in Figure 5-1.

Table 5-1. Contaminated sites in the Dutch Harbor study area (OASIS 2006)

Contaminated Site Description	Summary of Contamination	Potential Risk to Water Quality (OASIS 2006)
Pre-World War II Tank Farm		
Constructed in the 1920s, the site included four 425,000-gallon above-ground storage tanks (ASTs) and six smaller ASTs.	In 1942, the ASTs were drained, likely to prevent damage during Japanese bombing raids on Dutch Harbor. This may have caused more than one million gallons of petroleum fuel to be released. In 1943, the tank farm was demolished and four feet of clean fill was placed over the area. In 1989, the USACE began site	High

Contaminated Site Description	Summary of Contamination	Potential Risk to Water Quality (OASIS 2006)
	characterizations, remedial investigations, and removal actions. Oil-saturated soil measured at >10 feet thick. More than 13,000 cubic yards of contaminated soil have been excavated and thermally treated since 1998. Fieldwork conducted in 2003 and 2004 found that Bunker C fuel located on top of groundwater is still present between the site and the shoreline of Dutch Harbor.	
Rocky Point		
This bulk petroleum storage and distribution facility has been in operation for more than 60 years. Initially operated by the military, the facility was then leased to Standard Oil of California (Chevron) after World War II and until 1986, when Delta Western Fuels took over operations. USACE began site characterizations, remedial investigations, and removal actions in 1989. The area was historically served by a network of underground World War II-era pipelines. These pipelines leak fuel slowly and continuously, complicating remediation efforts. An on-going work-plan to replace the old pipelines is in place. The site is sub-divided in to five management units: Lower Tank Farm, Tank Hill, Strawberry Hill, Upper Tank Farm, and Pipeline Corridors.	Lower Tank Farm – This unit was constructed in 1942 and had 13 ASTs containing petroleum fuels. The destruction of four tanks during World War II caused the release of 924,000 gallons of Bunker C and 624,960 gallons of diesel fuel. In 1967, a leak of unknown quantity again impacted Iliuliuk Bay. A 1974 leak released up to 8,000 gallons, but it was reported that the product was recovered before reaching water. Five tanks were removed and later replaced by Delta Western, the current operator.	High
	Tank Hill – This unit was constructed in 1943 and had five USTs for fuels. In the 1950s, the contents of three of the tanks were released into trenches, creating two tar ponds currently being managed as contaminated sites. Overfilling of one UST in 1974 caused the release of ~20,000 gallons of fuel. Small volume releases also occurred in 1983 and 1986. The area is no longer used for fuel storage, but the USTs remain in place.	
	Strawberry Hill (Tank 17/18 Area) – Two USTs that contained Bunker C fuels were constructed on the eastern edge of Strawberry Hill in 1943. In the late 1980s, approximately 1,500 gallons of diesel fuel were released. Two tar ponds are associated with this release, similar to the tar ponds at Tank Hill. Tanks are not currently in use.	
	Upper Tank Farm – This unit was constructed in 1960s by Chevron and includes six ASTs, ranging in capacity from ~100,000 to 1,600,000 gallons containing various petroleum fuels. Unit is currently operated by Delta Western. Fuel from these tanks is gravity-fed to the dock and truck loading rack on the north side of Rocky Point. No releases from these tanks are documented.	
	Pipeline Corridors – Active and inactive above-ground and below-ground pipelines exists in Rocky Point. Underground pipelines were constructed by the military, while the above-ground pipelines were constructed by Chevron and Delta Western. Delta Western has an ongoing program to uncover, upgrade, and maintain the pipelines. In 1993, a fuel release was discovered from a below-ground 3-inch pipeline that ran through the APL dock yard. These pipelines were known to be a chronic source of slow, continual releases of petroleum products. Most of the lines have now been removed or properly closed with only a few still needing to be addressed.	
Former Aqua Fuel System #1		
Originally used to transfer fuel from the Delta Western dock to the airport via pipelines, the system was located just north of the current Unalaska Powerhouse and across East Point Road from the airport.	Delta Western identified and removed eight 25,000-gallon USTs in 1991. A subsequent Phase II Environmental Assessment Report for the aqua system in 1993 identified petroleum-contaminated soil. A portion of pipeline from the airport apron to the fuel system was removed in 1998. Groundwater monitoring has demonstrated that petroleum levels in groundwater meet site specific cleanup levels, and groundwater that discharges to surface water meets water quality criteria for petroleum.	Low

Contaminated Site Description	Summary of Contamination	Potential Risk to Water Quality (OASIS 2006)
Fort Mears Area		
Site is located on the narrow portion of Amaknak Island near Margaret Bay. Sites include Margaret Bay Post Office, Alaska Commercial Company, and General USTs.	Abandoned USTs and fuel contaminated soil were encountered during construction projects in the mid-1990s. As a result, during the late 1990s, 28 USTs were identified and decommissioned. Petroleum contaminated soils were removed, and analytical results of confirmation samples indicated that residual contamination is below ADEC cleanup levels with the exception of one soil sample. Soil and groundwater contamination and USTs in the area of the former Fort Mears gas station was discovered during various construction projects in the mid-1990s. The USTs were removed, and analytical results from confirmation soil and groundwater samples were less than ADEC cleanup levels.	Low
Former Mount Ballyhoo Spit Tank Farm		
Site was located at the base of Mount Ballyhoo at the head of Ballyhoo Spit.	The site included at least four large ASTs. In 1998, four test pits found no petroleum contamination. Groundwater from temporary well points did not exceed applicable cleanup levels. Also, a pipeline that ran from the former tank farm was removed and site characterization did not identify any releases.	Low
Alyeska Seafoods Processing Plant		
Site is located in the City of Unalaska on Iliuliuk Harbor.	Soil contamination resulted from a UST gasoline spill. The UST was closed in place in 1995 and ~150 cubic yards of contaminated soil were treated. Residual soil contamination above soil cleanup levels remains under a building. ADEC has issued a “No Further Action” determination for the site with a notice requirement for the property deed.	Low
AT&T Alascom Unalaska Earth Station		
Site is located to the east of Alyeska Seafoods Processing Plant in the City of Unalaska on Iliuliuk Bay.	Site has subsurface soil and groundwater petroleum contamination related to a UST release. Concentrations of DROs have been detected as high as 15,000 mg/kg in soil and 61 mg/L in groundwater. Corrective action planned for 2006 includes the construction of a bio-pile for excavated soils and the injection of oxygen releasing compound to groundwater.	Low
Unalaska Landfill		
Landfill is located on Unalaska Island to the east of Dutch Harbor.	The landfill is not listed in Contaminated Sites or LUST databases, but is discussed in this category due to the nature of landfill contents in general. The landfill has an unlined cell that has been closed since 1994. A new cell is operational, and it is lined and has a leachate collection system. Oily wastes, including oily rags or sorbent material, are prohibited in the new cell as part of the landfill’s Solid Waste Management Plan. Used oil is currently collected at a baler facility and is recycled as heating fuel for the landfill. Groundwater samples are collected quarterly, and surface water samples are collected semi-annually. Samples are analyzed for BTEX and have shown that these parameters do not exceed water quality criteria.	Low

Based on information contained in OASIS (2006)

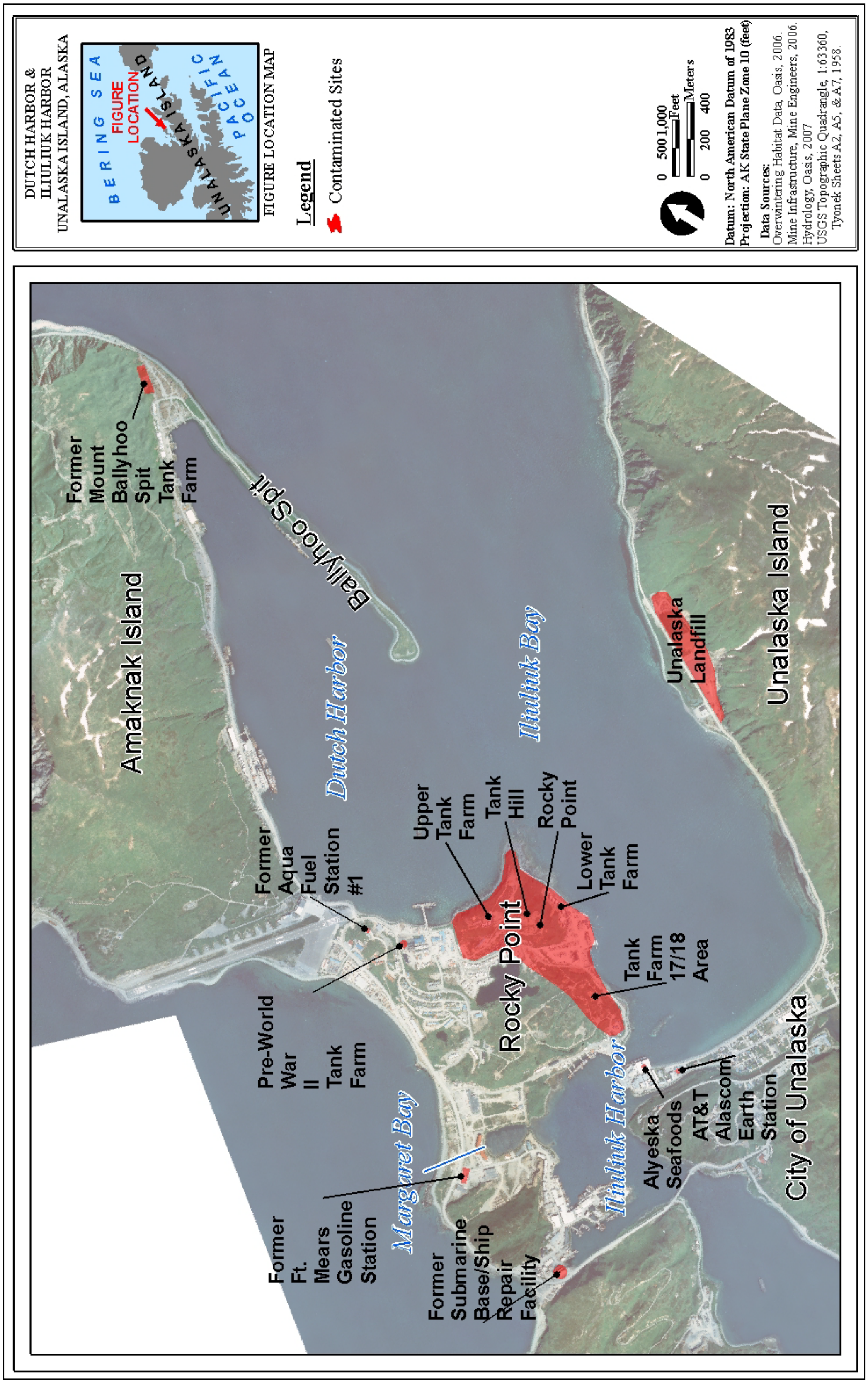

Figure 5-1. Contaminated sites in the Dutch Harbor study area (OASIS 2006)

5.2. Spills

Petroleum fuel spills have occurred frequently in the study area. Because development in the area is concentrated near shorelines and the local economy is reliant on sea-based industry, spills and releases often occur near or on the water. ADEC's Division of Spill Prevention and Response tracks reports of chemical spills through its Prevention and Emergency Response Program. The spills database (maintained since 1995) was reviewed to identify the frequency and distribution of petroleum spills in the study area as part of ADEC's 2006 *Dutch Harbor Water Quality and Impairment Analysis* (OASIS 2006).

Of 411 entries dating from July 22, 1995 to February 24, 2006, 80 were identified as potentially relevant to the petroleum impairments in the study area. These 80 spills released approximately 11,780 gallons of petroleum-related products with at least half known to have occurred either on the water or immediately adjacent to the water at a dock. The causes of the spills were grouped into the following categories:

- Human Factors – 38 spills, 6,635 gallons
- Structural/Mechanical Failures – 20 spills, 2,155 gallons
- Accident (Grounding or Collision) – 3 spills, 655 gallons
- Other or Unknown Factors – 19 spills, 2,335 gallons

Analysis of the spill data found that an average of 7.4 spills occurred per year releasing a median 898 gallons of petroleum related products. In 1997 the *M/V Kuroshima* ran aground in Summer Bay, near Iliuliuk Bay, and released approximately 39,000 gallons of Bunker C fuel. In addition to the spills for the study area described above, the grounding of the *M/V Selendang Ayu* in December 2004 released approximately 335,000 gallons of intermediate fuel oil and marine diesel on the northwestern side of Unalaska Island.

The consistency in which spills occur account for an average annual input of nearly 1,000 gallons of petroleum products into the study area. ADEC's 2006 assessment assigned spills a risk of medium to high for impacting water quality from the release of petroleum pollutants (OASIS 2006).

5.3. Stormwater

Urban Stormwater

Nearly all development in the greater Unalaska area is located on or near coastal areas. Stormwater runoff from roads and parking lots may be contaminated with petroleum hydrocarbons and, therefore, have the potential to affect water quality in the area.

Unpaved roads connect many of the developed land parcels in the study area. Roadside culverts collect stormwater from these areas and empty directly into marine waters. EPA's 1994 *Water Quality Assessment of Greater Unalaska Bay* identified approximately 100 culverts draining to marine waters and stated that approximately 50 percent of these drain to Iliuliuk Bay, Iliuliuk Harbor, and Dutch Harbor.

Recent road improvements in the area have replaced some of these direct drains. Over the past ten years, numerous road improvement projects have occurred, including paving and improving a number of roads in the area. As part of the improvements, the City of Unalaska installed new stormwater collection basins and outfalls. Each new basin has an oil/water separator to isolate any oils from continuing through the stormwater system to the outfall.

As of 2006, a total of 15 oil/water separators have been constructed in association with the road improvement projects. The City of Unalaska cleans out each oil/water separator about once per year

(OASIS 2006). While the oil/water separators operate to reduce petroleum inputs to impaired waterbodies through stormwater, the City of Unalaska does not have a stormwater management plan, and therefore, no institutional mechanism to manage and reduce pollutants from entering the impaired waters through stormwater.

In addition, snowfall accounts for a large portion of total precipitation in the study area. With no central snow storage impound existing for the city, snow plowed from streets in the City of Unalaska is moved to open beaches. This provides a pathway for direct input of pollutants that have accumulated in the snow to enter the impaired waterbodies as snow melts.

As part of the 2006 impairment assessment, stormwater was categorized as an existing low to medium risk to impact water quality from the release of petroleum pollutants (OASIS 2006). The mass of petroleum pollutant input from stormwater is likely low, and the distribution of stormwater outfalls is spread across a wide area from the City of Unalaska to Ballyhoo Spit. Stormwater samples were collected in 2008 as part of the 2007–2008 monitoring studies as discussed in Section 4.2. All samples showed concentrations below the applicable water quality criteria for PAHs (15 µg/L), with two of the three samples having concentrations low enough to require estimation. However, the sample collected at outfall ST-22 at the head of Dutch Harbor showed a significantly larger concentration (6 µg/L) and was described as having the potential to affect water quality. Stormwater samples were also collected in the late 1990s from the Rocky Point area, which is a known area of contamination (OASIS 2006). These showed that while petroleum constituents were present in the discharge, the concentrations were less than State water quality criteria. The main concern with stormwater is that rainfall is so frequent in the study area that it is a nearly continuous discharge. Therefore, if there was a spill in an area subject to stormwater runoff, it has the potential to be quickly delivered to the affected waterbodies.

Regulated Stormwater

As part of the NPDES program, EPA maintains the Electronic Notice of Intent database for construction sites and industrial facilities that need to apply for coverage under EPA's Construction General Permit or Multi-Sector General Permit for stormwater. A review of the database identified several active construction permits and two active no exposure permits in the study area (Table 5-2). Stormwater from construction facilities are short-term, temporary discharges and are assumed to be an unlikely source of petroleum. In addition, sites covered under the *NPDES General Permit for Stormwater Discharges from Construction Activities* are required to implement control measures to "prevent litter, construction debris, and construction chemicals (e.g., diesel fuel, hydraulic fluids, and other petroleum products) that could be exposed to stormwater from becoming a pollutant source in stormwater discharges." Active no exposure permits AKRNEB467 and AKNOECB02 are associated with fuel storage sites at Delta Western, Inc. However, these facilities' conditions of no exposure certify that all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff, therefore preventing the runoff and discharge of pollutants in stormwater. These petroleum storage facilities are discussed further in Section 5.5. The UniSea, Inc., facility was previously covered under a no exposure permit, but according to information provided by a company representative during the public comment period, the facility no longer has a no exposure certification and is now covered under the MSGP and has submitted a stormwater pollution prevention plan (SWPPP). Because the facility operates under a SWPPP that includes management practices to minimize discharge of petroleum and respond effectively to accidental spills, it is not expected to be a source of petroleum, and therefore does not have a WLA in this TMDL.

Currently no other facilities have been issued or applied for permit coverage under the Multi-Sector General Permit. Any future industrial stormwater sources would be required to meet the minimum measures and requirements of the stormwater permit. This would include implementing pollution prevention practices to prevent the spill or release of petroleum-related products and to effectively respond to such spills/releases to prevent exposure to stormwater runoff and delivery to receiving waterbodies.

Table 5-2. Study area facilities operating under general stormwater permits

Permit Tracking Number	Application Type	Status	Organization Name	City	Area (acre)	Receiving Water
AKRNEB467	No Exposure	Active	Delta Western, Inc.	Dutch Harbor		None given
AKNOECB02	No Exposure	Active	Delta Western, Inc.	Dutch Harbor	2	None given
AKR05DA38[a]	Industrial	Active	Unisea, Inc.	Dutch Harbor		None given

a. The UniSea facility was previously listed in eNOI as having a no exposure certification. However, information provided by the company during the public comment period noted that the facility is now covered under the MSGP under permit number AKR05DA38 and has developed and submitted the required SWPPP.

5.4. NPDES Permitted Facilities

Seafood processing is a major industry of the Unalaska/Dutch Harbor economy, and facilities operate both onshore and offshore throughout the study area. Effluent discharges from these facilities are regulated using both general and individual NPDES permits. Three seafood processors currently operate and have permits to discharge within the study area: Icicle Seafoods, which operates two floating facilities (*Bering Star* and *Arctic Star*) at the head of Dutch Harbor under a general permit and Alyeska Seafoods and UniSea, Inc., both of which operate within Iliuliuk Harbor under individual permits. Table 5-3 presents a summary of these processors' permits. Figure 5-1 shows the locations of the facilities in the study area.

Only Icicle Seafoods discharges process waste water to a water body in the study area, Iliuliuk Bay. All three facilities, however, discharge non-contact cooling water directly to the study area. These non-contact cooling waters are categorized as one of the following: cooling water, boiler water, fresh water pressure relief discharge, refrigeration condensate, or live tank water. The current NPDES permits prohibit the discharge of petroleum. The permits do not contain any monitoring requirements for petroleum pollutants, however. Therefore, no documentation exists to determine whether petroleum pollutants are contained in the facilities' effluents. In addition, it is unknown whether the listed permits have been renewed. A review of EPA's Permit Compliance System database found the expiration dates presented in Table 5-3, all of which are past due.

Icicle Seafoods is covered under the Alaskan Seafood General Permit, while the other two facilities have individual permits. The general permit does not authorize any pollutants which are not expressly authorized in the permit, including petroleum hydrocarbons. The individual permits do not include limits for petroleum hydrocarbons since they are not pollutants associated with the facility's operation and discharge. While the discharges from seafood processors likely are not a source of petroleum given the nature of the operations, the high volume of discharge and the lack of analytical documentation, OASIS (2006) categorized the facilities as an existing low risk to impact water quality with petroleum pollutants.

In addition to the NPDES permitted facilities identified by OASIS (2006), a search of EPA's permit compliance database found an additional permitted facility Electrical Utility Powerhouse (NPDES AK0040550), discharging in the study area. The permit listing for the City of Unalaska Electrical Utility Powerhouse notes Dutch Harbor as the receiving water for the permitted discharge. The database did not include any permit limits information for the facility. Results from sediment sampling near the facility outfall at stations SD-35 and SD-36 were below the TEL for total PAHs, and outfall water quality at SW-25 and SW-26 also met applicable petroleum hydrocarbon criteria.

Table 5-3. Seafood processors operating under NPDES permits

Facility	NPDES Permit ID	Expiration Date	Type	Receiving Waterbody	Regulated Parameters
Icicle Seafoods (Bering Star and Arctic Star	AKG520082	7/27/2006	001	Illiuliuk Bay	▪ Solids ▪ Dissolved oxygen ▪ Floating and suspended residues ▪ Color ▪ Turbidity ▪ Temperature ▪ pH ▪ Fecal coliform ▪ Total residue chlorine
Alyeska Seafoods	AK0000272	3/31/2008	002 (Non-contact cooling water)	Illiuliuk Harbor	▪ Temperature ▪ Flow
			003 (Scrubber/ condenser effluent)	Illiuliuk Harbor	None
Unisea, Inc.	AK0028657	3/31/2008	002 (Non-contact cooling water)	Illiuliuk Harbor	▪ Temperature ▪ Flow
			Scrubber/condenser effluent	Illiuliuk Harbor	None

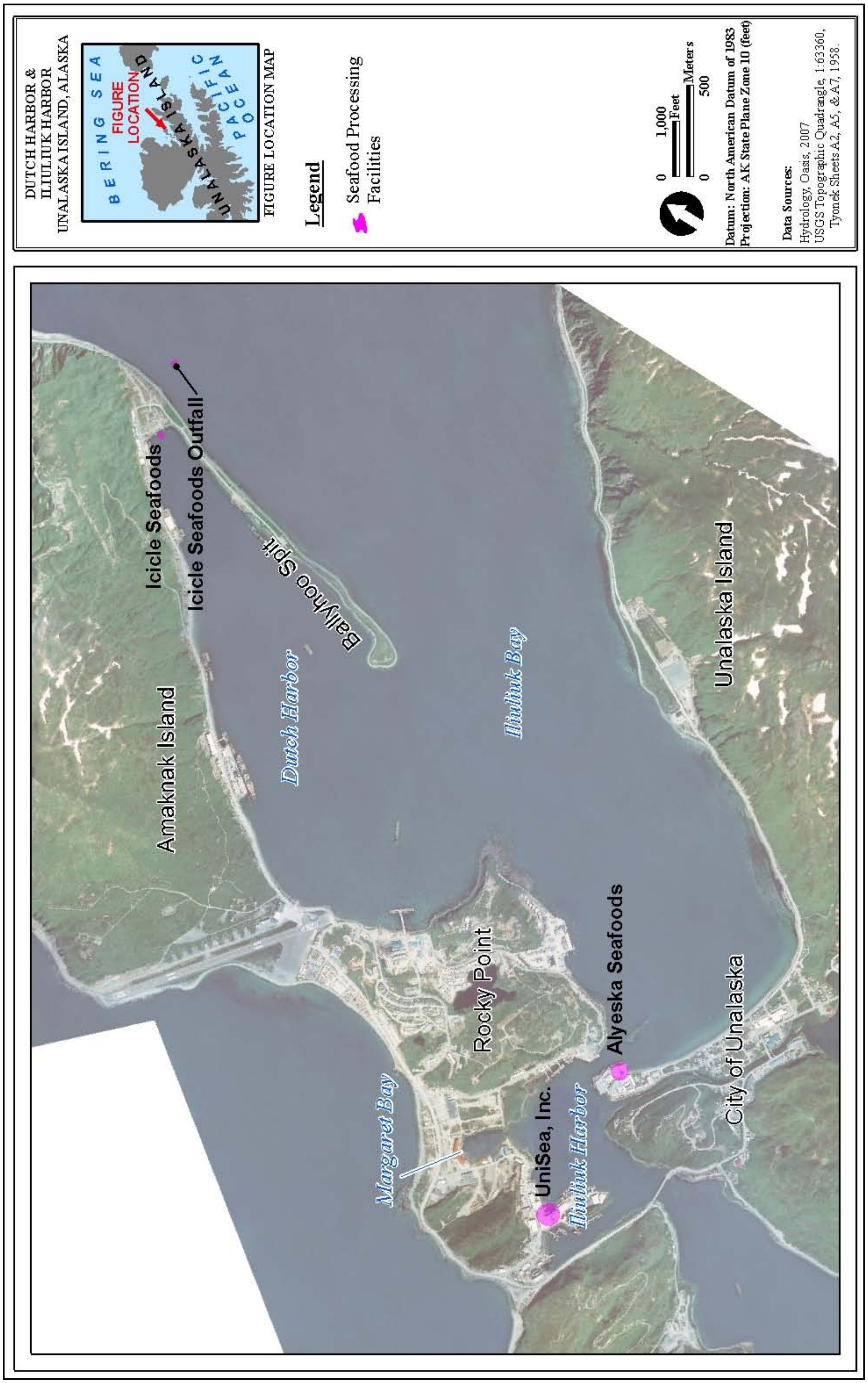

Figure 5-2. Seafood processors located in the Dutch Harbor study area (OASIS 2006)

5.5. Petroleum Storage and Transfer Facilities

Three bulk fuel storage and transfer facilities are located along the shore of Dutch Harbor. Owned and operated by two companies, Delta Western and Petro Star, Inc., the facilities—Delta Western, North Pacific Fuel Ballyhoo Road, and North Pacific Fuel Resoff Terminal—store a combined total of approximately 20 million gallons of fuel in 35 ASTs. These facilities offer residential and commercial heating fuel and commercial deliveries of diesel, gasoline, marine, and aviation fuels.

Delta Western facility distributes fuels to vessels from their dock located on Rocky Point at the south end of Dutch Harbor. The two North Pacific Fuel facilities are located at the north end and center of Dutch Harbor and are the main fuel supplier for municipal docks in the area. Deliveries to the municipal docks occur via pipeline to the large docks and via fuel tanker trucks to the smaller docks. Table 5-4 summarizes tank and capacity information for these facilities, and Figure 5-3 shows the locations of each in addition to the locations of seafood processors in the area.

The facilities have current Facility Response Plans that require comprehensive spill response measures that include requirements for facility and response self-inspection, training, and spill response exercises and drills. The three facilities appear to have implemented BMPs, developed the appropriate plans for spill scenarios, and properly managed their operations. There is no indication that these facilities are chronic sources of petroleum pollutants for the study area; however, given the fact that almost 20 million gallons of fuel are stored within close proximity to Dutch Harbor and Iliuliuk Bay, these facilities pose a potential high risk to impact water quality from the release of petroleum pollutants.

Table 5-4. Petroleum storage and transfer facilities in the Dutch Harbor study area

Company	Location Name	Number of Tanks	Combined Approximate Capacity (gallons)
Delta Western Fuels	Delta Western—Rocky Point	17	16,000,000
Petro Star, Inc dba North Pacific Fuel	North Pacific Fuel Ballyhoo Road	8	1,700,000
Petro Star, Inc dba North Pacific Fuel	North Pacific Fuel Resoff Terminal	7	2,300,000

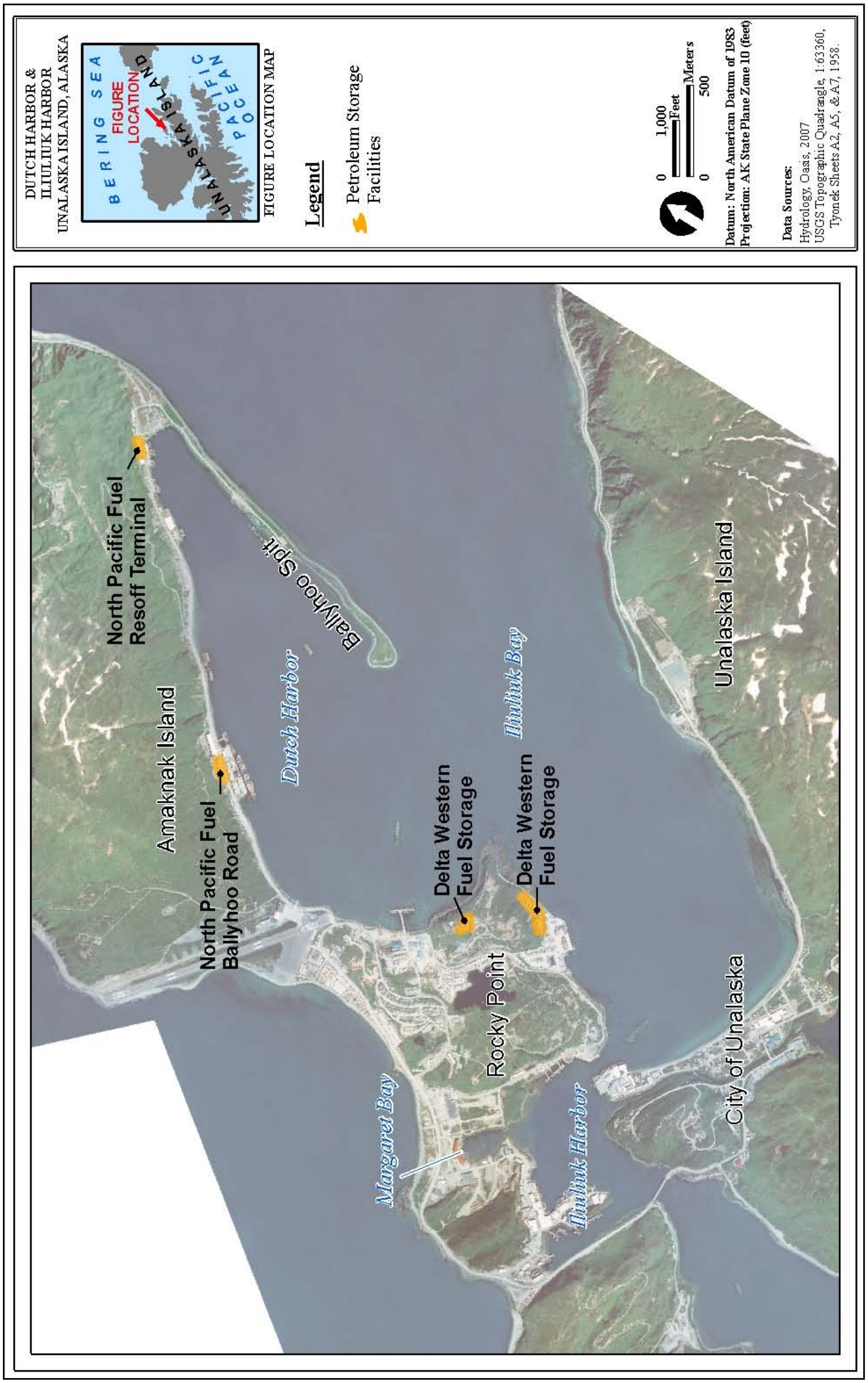

Figure 5-3. Fuel storage facilities located in the Dutch Harbor study area (OASIS 2006)

5.6. Docks and Harbors

Numerous docks and harbors serve the marine-based economy of the study area. All of these facilities have the potential to contribute petroleum pollutants to surface waters through their operations, including boat discharges of oily bilge water, fueling, and fuel transfers. Docks that provide fueling services are of particular concern because of the potential for spills to surface waters. Table 5-5 lists the docks and harbors in Dutch and Iliuliuk Harbors, and Figure 5-4 shows the locations of the facilities.

Table 5-5. Docks and harbors in Dutch and Iliuliuk Harbors

Dock/ Harbor	Description
Publicly Owned	
UMC / Coast Guard Dock	UMC offers cargo, passenger, and other port services, including support of Coast Guard and other government vessels, ferries, cruise ships, container ships, barges, and fishing support vessels. It consists of approximately 2,051 linear feet of dock face. Horizon Lines operates a 30-ton crane and rail system for containerized cargo, and North Pacific Fuel operates fueling facilities. Fueling operations are conducted at all mooring positions by pipeline or tank trucks.
Light Cargo Dock	Built in 2000, the light cargo dock consists of two sheet pile docks. It was designed for handling crab pots and is not very suitable for moorage or handling of other cargo. Because of this design feature, the dock is not heavily used except before and after the crab seasons. It does not provide fueling services.
Spit Dock	The Spit Dock offers multiple berths with long- and short-term moorage for vessels up to 200 feet in length. The Spit Dock facility measures 2,400 linear feet. Shore-power, refuse removal, and fresh water are offered, but fueling operations are not.
Small Boat Harbor	Located in Iliuliuk Harbor, the Small Boat Harbor provides long-term moorage for personal craft and small fishing vessels up to 60-feet long. The facility does not provide fueling services, but does provide freshwater, shore-power, waste oil, and refuse removal.
Privately Owned	
Delta Western Dock	The Delta Western Dock supplies the area with residential and commercial heating fuel, gasoline and diesel fuel, aviation fuel, as well as supplying marine fuels and lubricants. The dock is 430-feet long and services everything from small boats to large commercial fishing vessels and cruise vessels.
Trident Seafoods Dock	The Trident Seafoods Dock provides support and services to the Trident Seafoods fishing fleet.
North Pacific Fuel Dock	North Pacific Fuel Dock is a marine fueling facility operated by Petro Star, Inc.
Magone Marine Dock	The Magone Marine Dock is located just to the north of the UMC / Coast Guard Dock in Dutch Harbor. It does not include fueling operations, but its operations include a significant volume of marine repair, salvage, and response activities.
UniSea Dock	UniSea, Inc. operates a dock, measuring 1,541 linear feet, designed for off-loading fish to the UniSea processing plant. On average, there are twelve 100 to 200 foot vessels docked at UniSea during the main in-seasons of fisheries. There is typically always a boat docked at the processing plant, but the number of vessels docked at one time depends upon which fishery is in-season.
Alyeska Seafoods Dock	There is approximately 330 feet of total berthing space at the Alyeska Seafoods Dock. The Alyeska Seafood facility is in production eight months a year. During this time, 20 boats regularly dock at the docking facility while they are unloading fish. During the off-season, many of these vessels are moored at the dock.
Coastal Transportation East Point Dock	The Coastal Transportation East Point Dock provides support and service to cargo ships visiting Dutch and Iliuliuk Harbors.
APL Dock	The APL container dock is located in Iliuliuk Bay and provides major port services, including container transfer, storage facilities, and fueling. It is located approximately

Dock/ Harbor	Description
	½-mile southwest of Rocky Point and abuts the Rocky Point Lower Tank Farm contaminated site. Originally constructed in the early 1940s, the dock was expanded and its fuel distribution system updated in 1994 to address problems with oil seepage. As part of the 1994 expansion, a retaining wall with an oil/water separator was built, separating the site from the Rocky Point Lower Tank Farm.
Walaskek Shipyard	Walashek Shipyard provides major boat repairs at the site of the Former Submarine Base / Ship Repair Facility in Iliuliuk Harbor

The City of Unalaska, Department of Ports and Harbors, manages the UMC / Coast Guard Dock, the light cargo dock, Ballyhoo Spit dock, and small boat harbor. The Delta Western Dock, Trident Seafoods Dock, North Pacific Fuel Dock, Magone Marine Dock, UniSea Dock, Alyeska Seafoods Dock, Coastal Transportation East Point Dock, APL Dock, and Walaskek Shipyard are all privately owned and operated. At peak times, private and public facilities in Unalaska accommodate approximately 184 large (from 60 feet to 200 feet in length) vessels, but for long-term moorage, the number of vessels in Unalaska averages about 80 percent of this number, or approximately 150 vessels. The area has accommodations for approximately 132 vessels without rafting.

The public docks are managed under a master BMP plan developed by the City of Unalaska, while private docks might have FRPs; Spill Prevention, Control and Countermeasure (SPCC) Plans; or other contingency plans, based on the nature of operations at each facility. The small boat harbor is owned and operated by the City of Unalaska, but because of its unique capability to serve smaller personal watercraft, it is managed under a site-specific operations plan as opposed to the master Best Management Plan.

Based on variable management conditions, it is difficult to assess the risk posed by dock and harbor facilities in Dutch and Iliuliuk Harbors. This degree of difficulty also stems from the requirement of individual responsibility to comply with BMPs and other controls. A large number of commercial and private vessels frequent the study area on a year-round basis and require services at the various docks and harbors. Vessels often keep fuel oil on deck in drums or other small containers and operate portable equipment with external tanks, which create the potential for spills if not properly stored. The release of oily bilge water also is a significant threat because boats moored at a facility for a long period will accumulate excessive water in their bilges. Many bilges are pumped automatically based on water level, and if the bilges are not properly inspected and maintained by owners and operators, these discharges can, and often do, contain oily mixtures.

In addition to the spills or discharges of petroleum products related to activities at docks and harbors as identified in the 2006 assessment, another potential source of PAHs from docks and harbors is the physical structures themselves. Creosote-treated wood pilings can represent a source of PAHs to surrounding sediments as creosote compounds leach from the wood. NOAA conducted a recent literature review of studies on the hazards to aquatic organisms from treated wood and the factors that affect the leaching of creosote from treated wood into aquatic environments (Stratus 2006). The study concluded that the observed and modeled PAH leaching rates from treated wood and the resulting environmental concentrations and risk vary greatly depending on site-specific conditions, including water temperature, salinity and flow rate, and wood type and treatment method. However, the review concludes that rate of leaching of PAHs is generally greater:

- in freshwater than in seawater;
- at high temperatures than at low temperatures;
- at high flow rates than at low flow rates;
- from less dense wood than from denser wood;

- from freshly treated wood than from wood that has either been stored after treatment or exposed to water.

Data available for Dutch Harbor from the 2007 and 2008 monitoring events indicate that individual PAHs that exhibit high concentrations and exceedances of TELs include pyrene, fluoranthene, anthracene, phenanthrene, and chrysene. These are all constituents of creosote; however, these PAHs are also common to combustion byproducts and petroleum products that can be delivered through urban runoff or oil spills. While the data do not indicate whether creosote-treated wood is a source of PAHs to Dutch Harbor sediments, it is likely that treated pilings have contributed PAHs to surrounding sediments.

The initial 2006 analysis categorized docks and harbors as posing an existing medium to high risk to impact water quality from the release of petroleum pollutants (OASIS 2006), and subsequent monitoring results indicate areas with the most impacted sediments for petroleum hydrocarbons are located around docks and harbors. These will be the areas of focus for the TMDL and implementation measures.

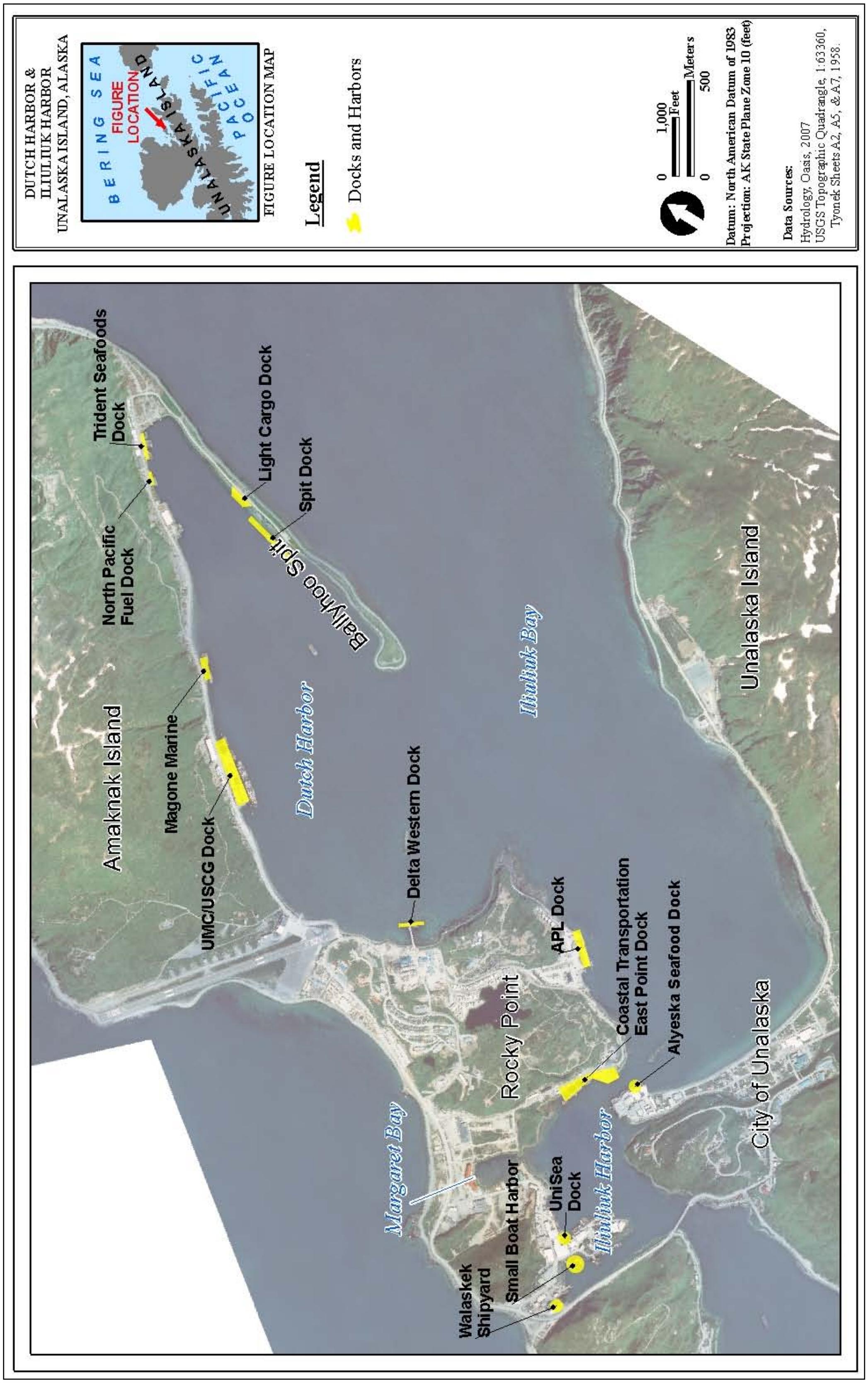

Figure 5-4. Docks and harbors in the Dutch Harbor study area (OASIS 2006)

6. TMDL Allocation Analysis

A TMDL represents the total amount of a pollutant that can be assimilated by a receiving water while still achieving water quality standards. A TMDL is composed of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background loads. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$ [1]

The analytical approach used to estimate the loading capacity and allocations for Dutch Harbor and Iliuliuk Harbor are based on the best available information to represent the impairment and expected sources.

6.1. Loading Capacity

The loading capacity for a given pollutant is the greatest amount of pollutant that a waterbody can receive without violating the applicable water quality standard, as reflected by the water quality target. If the target is a numeric criterion and discharge sources are present, the loading capacity can be calculated as the highest pollutant load that will not cause the criterion to be exceeded.

Surface water quality currently meets applicable petroleum hydrocarbon concentration standards in Dutch Harbor and Iliuliuk Harbor. Continued petroleum impairment in these water bodies is the result of sediment contamination causing oil sheens on bottom sediments. Sediment contamination is thought to be the result of historic spills and releases from upland and harbor sites that have been spread throughout the area by tidal and wave action along with current periodic spills at docks and harbors (OASIS 2006). Because the contamination is thought to be predominantly the result of historical activities and sources, the calculation of loading capacity focuses on existing sediment quality and the reductions necessary to meet the sediment quality TMDL target discussed in Section 3, accounting for a margin of safety.

The TMDLs for Dutch Harbor and Iliuliuk Harbor sediments are concentration-based (µg/kg), consistent with both Alaska's narrative water quality criterion (18 AAC 70.020) and the sediment numeric targets established for this TMDL. The loading capacities for petroleum hydrocarbons in Dutch Harbor and Iliuliuk Harbor are equal to the numeric targets identified in Section 3.2 and Table 3-2. The necessary reductions were calculated based on the maximum sediment total PAHs concentration observed in each area and the load allocation (equal to the loading capacity of 1,684 µg/kg total PAHs minus a 10-percent margin of safety). The following formula was applied to calculate the percent reductions required to meet the load allocation:

$$\text{Percent Reduction} = \frac{(\text{Maximum Measured Concentration} - \text{Load Allocation})}{(\text{Maximum Measured Concentration})} \times 100$$

Loading capacity, load allocation and corresponding percent reductions were calculated for subareas within Dutch Harbor and Iliuliuk Harbor to account for the five impairment areas discussed in Section 3.3

[1] When TMDL allocations are expressed as loads, the loading capacity is divided into allocations to individual sources (and margin of safety, if explicit); therefore, the sum of the allocations is equal to the loading capacity. However, when a TMDL is expressed as a concentration or other measure, this equation might not apply. If expressed as concentrations, the allocations are typically equal to a concentration target that represents the loading capacity; therefore all allocations are equivalent to, rather than a portion of, the loading capacity.

and shown in Figure 3-1. To support and target implementation activities, the five impairment areas were further split to account for varying potential sources and existing conditions within each, giving a total of seven allocation areas. Figure 6-1 and Figure 6-2 show the allocation areas and sampling sites where the loading capacity was exceeded.

6.2. Wasteload Allocation

There are currently no known active permitted discharges of petroleum hydrocarbons to Iliuliuk Harbor or Dutch Harbor. Therefore, wasteload allocations for these TMDLs are not applicable and the available loading capacity is allocated as a gross allotment to the load allocation (nonpoint sources) minus the margin of safety, as summarized in Table 6-1. If future activity is proposed within Dutch or Iliuliuk Harbors that will entail discharge of petroleum hydrocarbons, the TMDL may be revised to include modified waste load allocations. Possible revision of the waste load allocation in this TMDL will depend on analysis of relevant factors at that time.

6.3. Load Allocation

The impairment conditions in Dutch and Iliuliuk Harbors are thought to be the result of historical contamination and activities that are potentially exacerbated by current sources, such as occasional oil spills, and the day-to-day heavy boat traffic, maintenance, and docking activities associated with the large shipping and fishing industries that use the harbors. There are no confirmed existing nonpoint sources of petroleum hydrocarbons affecting the impaired areas other than existing PAH concentrations in the sediments.

The load allocation for petroleum hydrocarbons in Dutch and Iliuliuk Harbors is equal to the loading capacity, minus the margin of safety. The load allocation is summarized in Table 6-1 and Figure 6-3. Because data are not available to calculate the contribution of individual sources to impairment or establish a predictive link between the various inputs and the resulting sediment concentration, the load allocation can be considered gross allocations to all sources.

Table 6-1. TMDL allocations for Dutch Harbor and Iliuliuk Harbor

Impairment Area	Sub-area	Total PAHs (µg/kg)					Percent Reduction to Meet LA
		Loading Capacity	WLA	LA	MOS	Maximum Observed	
Dutch Harbor	Ballyhoo Spit	1,684.0	NA	1,515.6	168.4	6,586	77.0%
	Northern Dutch Harbor	1,684.0	NA	1,515.6	168.4	14,560	89.6%
	Rocky Point	1,684.0	NA	1,515.6	168.4	11,659	87.0%
Iliuliuk Harbor	Southwest Iliuliuk Harbor	1,684.0	NA	1,515.6	168.4	112,840	98.7%
	Small Boat Harbor	1,684.0	NA	1,515.6	168.4	5,210	70.9%
	Central Iliuliuk Harbor	1,684.0	NA	1,515.6	168.4	94,455	98.4%
	Northern Iliuliuk Harbor	1,684.0	NA	1,515.6	168.4	99,569	98.5%

WLA = wasteload allocation
LA = load allocation
MOS = margin of safety
NA = not applicable

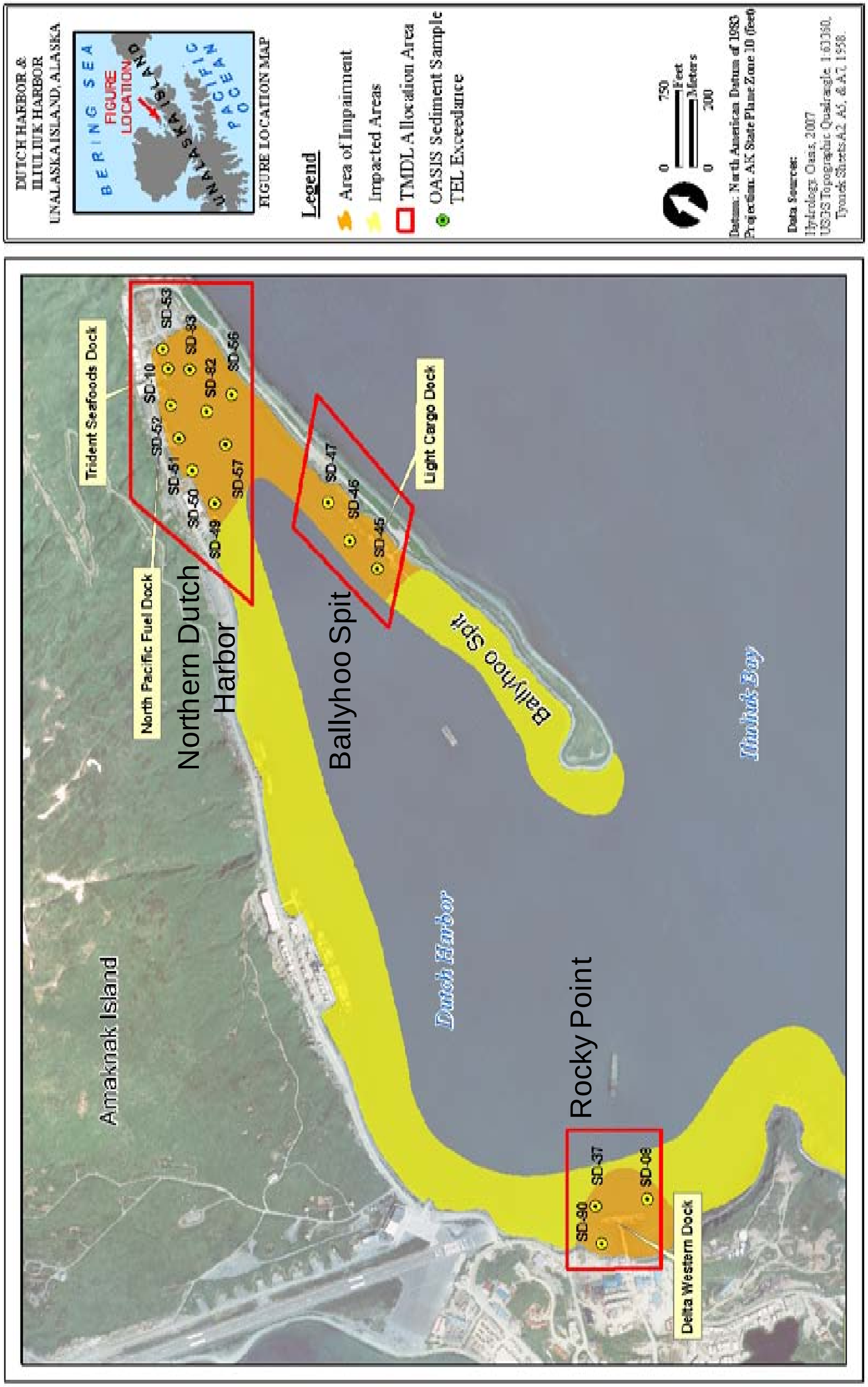

Figure 6-1. TMDL allocation areas and associated sampling sites—Dutch Harbor

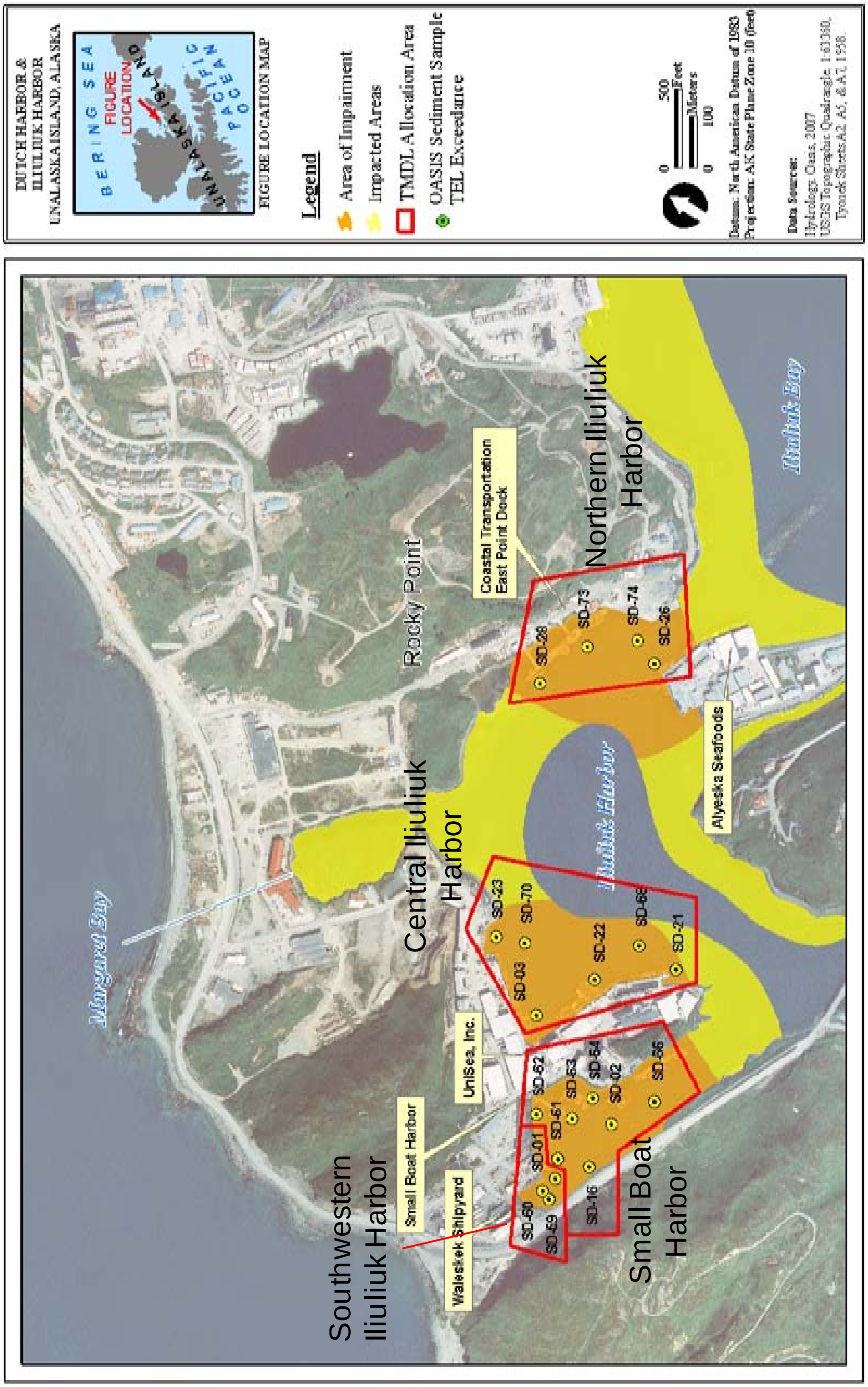

Figure 6-2. TMDL allocation areas and associated sampling sites—Iliuliuk Harbor

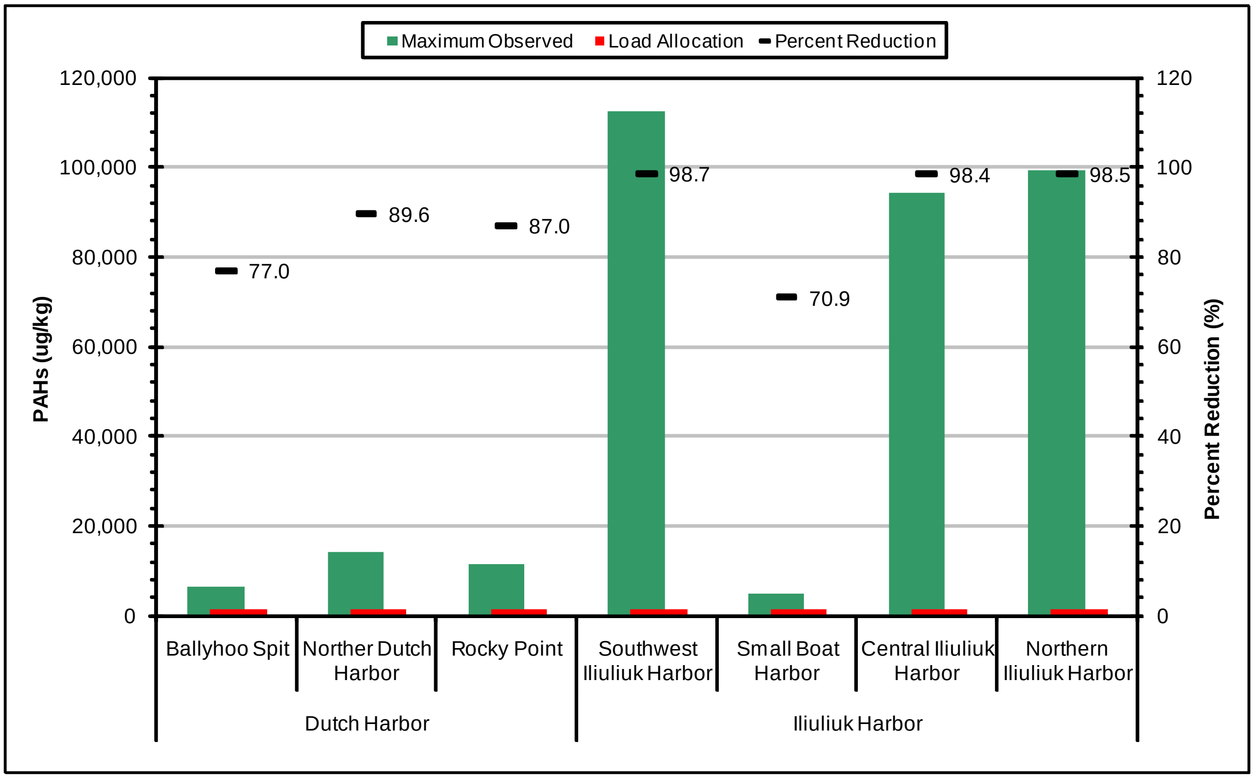

Figure 6-3. TMDL load allocations for Dutch Harbor and Iliuliuk Harbor

6.4. Margin of Safety

A margin of safety must be included in a TMDL to account for any uncertainty or lack of knowledge regarding the pollutant loads and the response of the receiving water. The margin of safety can be implicit (incorporated into the TMDL analysis through conservative assumptions) or explicit (expressed in the TMDL as a portion of the loadings) or a combination of both. As shown in Table 6-1, the margin of safety for total PAHs is explicit with 10 percent of the loading capacity reserved as the margin of safety to account for uncertainties in the TMDL. The margin of safety also includes an implicit component derived from the conservative TEL target for the TMDL. TELs define chemical sediment concentrations below which toxic effects are rarely observed in sensitive species.

6.5. Seasonal Variation and Critical Conditions

TMDLs must be developed with consideration of seasonal variation and critical conditions. Seasonal variation and critical conditions associated with pollutant loadings, waterbody response, and impairment conditions can affect the development and expression of a TMDL. A TMDL should include waste load allocations (permitted point sources) and load allocations (nonpoint sources) that ensure the waterbody will maintain water quality standards under all expected conditions.

The impairment in Dutch Harbor and Iliuliuk Harbor is not thought to be associated with a particular season or environmental condition. The impairment is a result of historical contamination from occasional oil spills and the day-to-day heavy boat traffic. The fishing industry is dominated by the ground fish catch and processing, which occurs year round. The peak fishing season occurs in winter, but year-round shipping, docking, and maintenance operations maintain a fairly consistent level of boat traffic, with nonpeak moorings of large vessels (60–200 feet) at about 80 percent of peak totals (Northern Economics 2004). Therefore, development of the TMDL for specific seasons and conditions is not necessary.

The TMDL loading capacity is based on the target Threshold Effects Level (TEL) for total PAHs in sediment. TELs define chemical sediment concentrations below which toxic effects are rarely observed in sensitive species and are considered protective during all climatic conditions. In addition, existing contamination levels were based on the maximum sediment PAH concentrations. These maximum levels capture the worst-case scenario for each impaired area, including the cumulative effects of sources over time. Therefore, the waste load allocations and load allocations and associated target reductions can be considered to be protective under all seasons and conditions.

6.6. Future Growth

Though no expansion of seafood industry operations is expected, dock and harbor infrastructures and services are planning to be expanded to meet current demands. According to Northern Economics (2004) existing demand for docking and mooring spaces for small and mid-size vessels is greater than what is available. Often boats are “rafted” to one another to make up for the lack of individual slips. In addition, the number of permanent residents of Unalaska is expected to grow modestly in the future, which may result in increased small boat traffic. Tourism is also expected to increase, which could lead to greater cruise ship and local small vessel traffic (Northern Economics 2004).

Though docking and mooring infrastructure are expected to expand, the total number of vessels using Dutch and Iliuliuk Harbor will likely remain relatively constant due to the stability of the fishery resources that are the driver of local industry. As a result, the number of inadvertent oil spills and petroleum hydrocarbon discharges associated with the shipping industry is also likely to be unchanged. The waters of Dutch and Iliuliuk Harbors are currently meeting applicable water quality criteria for the water column. So, existing activities do not appear to be affecting water quality. The impairments for which these TMDLs have been developed are based on elevated levels of petroleum hydrocarbons and oil sheens observed in sediments. These are thought to be predominantly caused be historical spills and spreading by tides and currents. While future growth is not anticipated to affect impairment status in the harbors, it is possible that future sources, such as facilities that will apply for coverage under the NPDES Multi-Sector General Permit, will have the potential to deliver petroleum hydrocarbons to the harbors. To address this, the TMDL establishes an allocation for future sources equivalent to the load allocation of 1,515.6 µg/mg to ensure that any future sources also meet established sediment quality targets.

6.7. Daily Load

The TMDLs for Dutch Harbor and Iliuliuk Harbor are presented as an allowable maximum concentration of PAHs in sediment. The allowable concentration is applicable at all times and can therefore be applied on a daily basis. This is consistent with the requirement to express TMDLs on a daily time increment.

7. Implementation

Current impairments in Dutch and Iliuliuk Harbors are located in the vicinity of docks. A large number of commercial and private vessels frequent the study area on a year-round basis and require services, including fueling, waste disposal services, and long-term moorage. These dock and harbor operations all have the potential to release petroleum hydrocarbons and impact water quality. The petroleum already attached to bottom sediments in the harbors is not likely to be remedied through physical removal. Therefore, restoration will rely on natural recovery as contaminated sediments are buried by "clean" sediment and on the control of any additional existing or future inputs. Therefore, the implementation of these TMDLs will focus on the continued management of shipping and docking operations in Dutch and Iliuliuk Harbors to prevent future spills.

7.1. Current Practices

Dutch and Iliuliuk Harbors have a high level of marine vessel traffic associated with the commercial fishing and seafood processing industries operating in the area. As a result oil and fuel spills to surface waters have the potential to occur. Major fuel spills can happen during fueling and fuel transfer operations, while vessels storing fuel oil on decks in drums and operating portable equipment with external fuel tanks can cause minor spills. The release of oily bilge water is also threat because boats moored at a facility for a long period will accumulate excessive water in their bilges. Many bilges are pumped automatically based on water level, and if the bilges are not properly inspected and maintained by owners and operators, these discharges can contain oily mixtures. Even small amounts of oil or fuel, if spilled, can have a detrimental effect on the environment.

The community continues to work on and improve its capability to handle oil and fuel spills, working with the Coast Guard for oil spill monitoring, adding equipment, and providing training for local residents. Fuel companies in Unalaska have also upgraded equipment, facilities, and training over the last several years to ensure safer fuel handling (AWCRSA 2003). General methods for reducing impacts from oil pollution associated with marine shipping and docking operations include:

- Employing strict operating and safety procedures wherever large quantities of petroleum products are involved. Alarm systems and security measures should be developed for all facilities handling oil to prevent spills caused by carelessness, vandalism, or sabotage.
- Operations conducted near oil storage areas should be conducted in a manner that does not contribute to the likelihood of an oil spill.
- Siting oil storage facilities a sufficient distance away from any open water, if possible, and constructing impermeable containment dikes that could contain the contents of the storage facilities in the event of a leak or catastrophic failure. Storage facilities should not be located in areas of high fish and wildlife concentrations or in geophysically unstable areas.
- Designing tanker docks and fueling facilities with automatic shut off systems and back-up safety systems.
- Effective oil spill containment and cleanup plans should be prepared and containment and cleanup equipment stationed in the region. Trained personnel should be available at all times to operate the equipment. Anchor points for oil exclusion booms should be identified at the mouths of all important fish streams, lagoons, and bays and at other sensitive areas. Under certain circumstances, approved chemical dispersants can assist in the protection of species and habitats sensitive to the physical effects of oil pollution, but the use of chemical dispersants should be

carefully considered since the dispersants could have deleterious effects on other species and/or habitats.

Because creosote-treated wood pilings might be leaching contaminants into surrounding sediments, owners of docks and harbors should consider the use of non-wood materials (e.g., steel, concrete, fiberglass) when building new structures or replacing existing pilings.

Docks and harbors in the study area are operated both publicly and privately. Operations at publicly owned and operated docks are managed under a master BMP plan developed by the City of Unalaska. Management practices at private docks may be guided by FRPs, SPCC plans, or other contingency plans based on the nature of operations at each facility. The following sections describe management practices currently in place at publicly and privately operated docks and harbors.

Management of Publicly-Owned Docks and Harbors

Four docks in the Dutch Harbor are managed by the City of Unalaska, Department of Ports and Harbors: the UMC/Coast Guard Dock, light cargo dock, Ballyhoo Spit dock, and small boat harbor. The three docks serving primarily commercial users—the UMC Dock, light cargo dock, and Spit dock— are operated under the City of Unalaska's Master BMP plan. Because of its unique nature of serving small private vessels, the small boat harbor operates under a separate management plan.

The Small Boat Harbor Operating Plan contains provisions to reduce the risk of petroleum hydrocarbon pollution. These include requirements that users will refrain from storing or placing waste oil or filters on dock common areas (floats, walkways, and parking areas) and that waste engine oil, used oil filters, and other oily waste be placed in oil disposal receptacles. Recent capital improvements included a waste oil disposal receptacle at each dock that includes three chambers for the three types of oil wastes including: oils that are compatible with "boiler blend" fuel (diesel, lubricating oil and hydraulic oil), non-blendable oils (transmission fluids, high temperature oils and greases, solvents and thinners), and oily solid wastes (rags, used oil filters, and used sorbent pads). The receptacles include signs to direct users as to which type of oil goes into which chamber.

The City of Unalaska's BMP Plan includes policies, procedures, and standards of care developed to ensure maritime operations have minimal impact on the region's environment and are conducted in compliance with applicable environmental regulations. City of Unalaska officials also ensure that contract fuel companies comply with Coast Guard regulations for Facilities Transferring Oil or Hazardous Materials in Bulk (33 CFR 154) and possess a Letter of Adequacy issued by the U.S. Coast Guard prior to operating. The Coast Guard regulations outline requirements for applicable facilities, including those related to development of an operating manual, equipment requirements, facility operations, and response plans for oil facilities. Even though the contract fuel provider and the vessel operator are ultimately responsible for any spills, the City of Unalaska provides a cache of oil spill response materials for immediate use to assist in the recovery of any oil spilled. BMP provisions for reducing the risk of oil and fuel pollution fall under four categories within the plan: fuel oil operations, oil spill prevention and response, vessel cleaning and maintenance, and communication. Each of these is discussed briefly below. The full text of the City of Unalaska's BMP Plan is available through ADEC or the City of Unalaska.

- Fuel oil operations BMPs are designed to ensure that contract operators are certified for the fuel services they offer to minimize the potential of accidental spills into the marine environment. They outline the responsibilities of the City of Unalaska to ensure operators are properly certified, trained, and equipped and provided operator fueling procedures to minimize spills.

- Oil spill prevention and response BMPs provide requirements for understanding and implementing the city's oil spill prevention and response plan and stipulate that lease agreements should require tenants and users to abide by and follow all applicable spill prevention and response regulations/ordinances. They also provide a response checklist in the case of an oil spill where the city is the responsible party and where a tenant is the responsible party.
- Vessel cleaning and maintenance BMPs provide cleaning and maintenance practices designed to prevent the inadvertent contamination of the environment by material and waste associated with vessel maintenance. Typically, vessel cleaning takes place either in the water, over the water, or on shore adjacent to the water. Pollutants generated from cleaning and maintenance activities can contain oils.
- Communication BMPs layout methods to clearly and logically convey the need for BMPs to protect the environment so that dock employees, tenants, and users can comply with their provisions. Communicating the practices can take several forms – contracts, pamphlets, signage, and formal awareness education.

Management of Privately Owned Docks and Harbors

Private owners and operators of facilities that store or use oil, including docks and harbors, have management responsibilities established by the Federal Oil Pollution Prevention regulations (40 CFR 112). Management practices include the development and implementation of SPCC plans and FRPs. The SPCC rule is the basis of EPA's oil spill prevention program. The FRP program is designed to ensure that certain facilities have adequate oil spill response capabilities.

The SPCC rule generally applies to non-transportation-related facilities with a total aboveground (i.e., not completely buried) oil storage capacity of greater than 1,320 gallons or total completely buried oil storage capacity greater than 42,000 gallons. In addition to the storage capacity criteria, a facility is regulated if due to its location the facility could reasonably be expected to discharge oil into navigable waters of the United States or adjoining shorelines, which applies to most docks and harbors (USEPA 2002).

The regulation requires that all regulated facilities have a fully prepared and implemented SPCC Plan. The SPCC Plan must be certified by a licensed professional engineer and the facility must implement the plan, including carrying out the spill prevention and control measures established for the type of facility or operations, such as measures for containing a spill (e.g., berms). In the event that a facility cannot implement containment measures, the facility must demonstrate that secondary containment is impracticable; conduct periodic integrity and leak testing of bulk containers and associated valves and piping; develop and incorporate a strong spill contingency plan into the SPCC Plan; and provide a written commitment of manpower, equipment, and materials required to quickly remove any quantity of oil discharged that may be harmful. In addition, facility owners or operators must conduct employee training on the contents of the SPCC Plan (USEPA 2002).

According to the Clean Water Act, as amended by the Oil Pollution Act of 1990, certain facilities that store and use oil are required to prepare and submit plans to respond to a worst case discharge of oil and to a substantial threat of such a discharge. EPA has established regulations that define who must prepare and submit an FRP and what must be included in the plan. An FRP is a plan for responding, to the maximum extent practicable, to a worse case discharge, and to a substantial threat of such a discharge, of oil. The Plan also includes responding to small and medium discharges as appropriate (USEPA 2002).

According to the Oil Pollution Act of 1990, an owner or operator of a "substantial harm" facility must develop and implement an FRP. A "substantial harm" facility is a facility that, because of its location, could reasonably be expected to cause substantial harm to the environment by discharging oil into or on navigable waters or adjoining shorelines. A dock meets this standard if the facility transfers oil over water to or from vessels and has a total oil storage capacity greater than or equal to 42,000 gallons (USEPA 2002).

The FRP helps an owner or operator develop a response organization and ensure the availability of response resources (e.g. response equipment, trained personnel) needed to respond to an oil discharge. The FRP should also demonstrate that the response resources are available in a timely manner, thereby reducing a discharge's impact and severity. The FRP also helps a facility owner or operator improve discharge prevention measures through the early identification of risks at the facility. In addition, FRPs aid local and regional response authorities to better understand the potential hazards and response capabilities in their area. Also, FRPs must be reviewed and updated periodically to reflect changes at the facility when the change may materially affect the response to a worst case discharge (USEPA 2002).

7.2. Recommendations

Existing management plans and BMPs provide a framework to minimize the risk of petroleum hydrocarbon pollution. More focus should be placed on enacting, educating, and enforcing BMPs at docks. To initiate a successful program, this effort likely will require interaction among multiple agencies, groups, and businesses, such as the Alaska Department of Fish and Game, the U.S. Coast Guard, the City of Unalaska Harbormaster, seafood processors, and marine transport companies. Currently, privately owned and operated docks are responsible for developing individual BMP programs. In the future, Dutch Harbor and Iliuliuk Harbor stakeholders should consider developing uniform BMPs for all docks and harbors. The group should include local, state, and federal government agencies that have a presence in the Unalaska area, private enterprises that would be directly affected, and any interested non-governmental organizations. This would allow for a consistent regulatory environment and easier implementation and enforcement.

In addition, monitoring efforts in the harbors should continue to determine whether natural recovery is occurring and concentrations of petroleum contaminants are decreasing over time due to natural sedimentation processes if the system is not disturbed. Monitoring will allow ADEC to track the progress of changes in water and sediment and determine whether acceptable progress is being made. Monitoring should also include further evaluation of potential stormwater sources and bioassays to determine whether petroleum impacted sediments are having a deleterious effect on benthic communities.

Additional bioassay tests should be performed to verify and supplement the results from this assessment. The available (OASIS 2009) results for the bioassay test are viewed as cursory because of the small sample size. An extensive bioassay sample program would be needed to understand the real toxicity of impacted sediments and to provide data that would be of sufficient quality for management decisions. It also would be useful to review plans for additional bioassay tests to ensure that appropriate sampling techniques, species, and analytical methods are used for decision-making purposes.

Additional monitoring of stormwater, especially at northern Dutch Harbor, should be considered. The concentration detected in the sample from outfall ST-22 during the September 2008 monitoring study may contribute to sediment contamination northern Dutch Harbor, and there are other outfalls that are located nearby that also may be contributing (OASIS 2009). The source of the polluted runoff is not known at this time.

8. Public Comments

On May 24, 2010, ADEC provided public notice of the draft TMDLs. Notice was provided on the State's Public Notice Web site, as a link from ADEC's Dutch Harbor project web site, published in the Anchorage Daily News statewide newspaper and in The Dutch Harbor Fisherman newspaper. Additionally, the notice was posted directly to community bulletin boards in the Unalaska area and sent directly (via email) to known stakeholders. A public informational meeting was held on June 16, 2010, in Unalaska at the city council chamber room. No one from the general public attended; however, six people representing the following organizations participated: City of Unalaska Public Works, UniSea, Inc., Alyeska Seafoods, and Icicle Seafoods. The presentation was filmed by the local public access TV station and the local public radio station KUCB interviewed ADEC staff after the public meeting regarding the draft TMDLs. The Pacific Fishing magazine also wrote an article on the draft TMDLs and posted a link to the KUCB interview. The opportunity to comment on the draft TMDLs closed June 28, 2010. The following comments were received in writing.

Tracking Number	Date Recd.	Affiliation of Commenter	Summary of Request or Comment	Summary of ADEC Action or Explanation
001	06-21-10	UniSea, Inc. Bishop, G.	On page 47 of the draft and table 5.2 on page 48, Regulated Stormwater, it describes UniSea as having an Active No Exposure stormwater permit. We [UniSea] had put in that notice several years ago and have since submitted a full SWPPP permit and plan, along with testing under the Multi Sector General Permit requirements.	Revised table 5.2 accordingly. MSGP SWPPP Tracking # AKR05DA38 Facility ID 4599.1, Permit ID 5651.1. Also updated paragraph text page 53 to reflect UniSea having MSGP SWPPP in place.

ADEC believes the low level of response was a result of 1) including the stakeholders in reviewing a pre-public draft of the TMDLs; 2) a coinciding oil abatement contingency program is being developed within the affected area and; 3) it being unlikely that the proposed TMDLs will limit economic growth in the affected waters or significantly impact daily activities at the seafood processing industries.

9. References

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Appendix: Summary of Sampling Locations and Dates Sampled

Table A-1 lists the sampling locations and sampling dates of stations monitored as part of the three ADEC assessments. During the two 2007 assessments, surface water samples were analyzed for BTEX and PAHs. Water samples collected during the 2008 assessment were analyzed for BTEX. Table A-2 lists the sediment sampling locations and sample types for each assessment. Surface sediment samples collected during the two 2007 assessments were analyzed for BTEX, PAHs and TOC. Surface and core samples collecting during the 2008 assessment were analysis for PAHs and TOC, and bulk samples were used for bioassay tests.

Table A-1. ADEC assessment surface water quality station sampling locations and dates

Sample Location	Location Description	Sample Type	Sample Depth (m)	Date Sampled		
				April 07	Sept 07	Sept 08
SW-01	Iliuliuk Harbor	Near-Shore	1	X	X	
			2.5	X		
SW-02	Iliuliuk Harbor	Near-Shore	1	X	X	
			5	X		
SW-03	Iliuliuk Harbor	Near-Shore	1	X	X	
			3	X		
SW-04	Iliuliuk Harbor	Near-Shore	1	X	X	
			5	X		
SW-05	Iliuliuk Harbor	Near-Shore	1	X	X	
			5	X		
SW-06	Margaret Bay	Near-Shore	1	X		X
			2.25	X		
SW-07	Iliuliuk Harbor	Near-Shore	1.5	X		
SW-08	Iliuliuk Harbor	Open Water	1	X	X	
			5	X		
SW-09	Iliuliuk Harbor	Near-Shore	1	X		
			5	X		
SW-10	Iliuliuk Bay-City of Unalaska	Near-Shore	1	X	X	
			5	X		
SW-11	Iliuliuk Bay-Front Beach	Near-Shore	1	X	X	
SW-12	Iliuliuk Bay-Front Beach	Near-Shore	1	X		
			5	X		
SW-13	Iliuliuk Bay-Front Beach	Open Water	1	X	X	
			1.75	X		
SW-14	Iliuliuk Harbor	Near-Shore	1	X	X	
			5	X		
SW-15	Iliuliuk Bay-	Open Water	1	X		
SW-16	Iliuliuk Bay-	Near-Shore	1	X	X	
			3.2	X		

Sample Location	Location Description	Sample Type	Sample Depth (m)	Date Sampled		
				April 07	Sept 07	Sept 08
SW-17	Rocky Point	Near-Shore	1	X		
			5	X		
SW-18	Rocky Point	Near-Shore	1	X	X	
			5	X		
SW-19	Rocky Point	Near-Shore	1	X		
			5	X		
SW-20	Rocky Point	Near-Shore	1.1	X		
SW-21	Iliuliuk Bay	Open Water	1	X		
SW-22	Iliuliuk Bay – landfill area	Near-Shore	1	X		
			5	X		
SW-23	Rocky Point	Near-Shore	1	X	X	
			2.5	X		
SW-24	Rocky Point	Near-Shore	1	X		
			2	X		
SW-25	Rocky Point	Near-Shore	1	X		
			2.5	X		
SW-26	Rocky Point	Near-Shore	1	X	X	
			1.75	X		
SW-27	Rocky Point	Near-Shore	1	X		
			3.5	X		
SW-28	Rocky Point	Near-Shore	1	X		
			5	X		
SW-29	Rocky Point	Near-Shore	1	X	X	
			2.2	X		
SW-30	Rocky Point	Near-Shore	1	X		
			4	X		
SW-31	Dutch Harbor	Near-Shore	1	X		
			5	X		
SW-32	Dutch Harbor	Open Water	1	X	X	
SW-33	Iliuliuk Bay	Open Water	1	X		
SW-34	Dutch Harbor	Near-Shore	1	X	X	
			5	X		
SW-35	Dutch Harbor	Near-Shore	1	X	X	
			5	X		
SW-36	Dutch Harbor	Near-Shore	1	X		
			5	X		
SW-37	Dutch Harbor	Near-Shore	1	X		
			5	X		

Sample Location	Location Description	Sample Type	Sample Depth (m)	Date Sampled		
				April 07	Sept 07	Sept 08
SW-38	Dutch Harbor	Near-Shore	1	X	X	
			5	X		
SW-39	Dutch Harbor	Near-Shore	1	X	X	
			5	X		
SW-40	Iliuliuk Harbor	Near-Shore	1		X	
SW-41	Iliuliuk Harbor	Near-Shore	1		X	
SW-42	Iliuliuk Harbor	Near-Shore	1		X	
SW-43	Iliuliuk Harbor	Near-Shore	1		X	
SW-44	Iliuliuk Harbor	Near-Shore	1		X	
SW-45	Iliuliuk Harbor	Near-Shore	1		X	
SW-46	Iliuliuk Harbor	Near-Shore	1		X	
SW-47	Iliuliuk Harbor	Near-Shore	1		X	
SW-48	Iliuliuk Bay-City of Unalaska	Near-Shore	1		X	
SW-49	Iliuliuk Bay-City of Unalaska	Near-Shore	0.8		X	
SW-50	Iliuliuk Bay-City of Unalaska	Near-Shore	1		X	
SW-51	Rocky Point	Near-Shore	1		X	
SW-52	Rocky Point	Near-Shore	1		X	
SW-53	Rocky Point	Near-Shore	1		X	
SW-54	Dutch Harbor	Near-Shore	1		X	
SW-55	Dutch Harbor	Near-Shore	1		X	
SW-56	Margaret Bay	Surface water	1			X
SW-57	Margaret Bay	Surface water	1			X
SW-58	Margaret Bay	Surface water	1			X

Table A-2. ADEC assessment sediment quality station sampling locations, dates, and types

Sample Location	Location Description	April 07	Sept 07	Sept 08			
				Grab			
		Grab*	Grab*	PAHs	TOC	Bioassay	Gravity core
SD-01	Iliuliuk Harbor	X	X	X	X	X	X
SD-02	Iliuliuk Harbor	X	X	X			X
SD-03	Iliuliuk Harbor	X	X	X			X
SD-04	Iliuliuk Harbor	X	X				
SD-05	Dutch Harbor	X					
SD-06	Rocky Point	X	X				
SD-07	Rocky Point	X					
SD-08	Rocky Point	X	X	X			
SD-09	Rocky Point	X	X				
SD-10	Dutch Harbor	X	X				

Sample Location	Location Description	April 07	Sept 07	Sept 08			
				Grab			
		Grab*	Grab*	PAHs	TOC	Bioassay	Gravity core
SD-11	Iliuliuk Harbor	X					
SD-12	Iliuliuk Bay	X					
SD-13	Rocky Point	X					
SD-14	Dutch Harbor	X					
SD-15	Dutch Harbor	X					
SD-16	Iliuliuk Harbor		X				
SD-17	Iliuliuk Harbor		X				
SD-18	Iliuliuk Harbor		X				
SD-19	Iliuliuk Harbor		X				
SD-20	Iliuliuk Harbor		X				
SD-21	Iliuliuk Harbor		X	X			
SD-22	Iliuliuk Harbor		X	X			X
SD-23	Iliuliuk Harbor		X	X			
SD-24	Iliuliuk Harbor		X				
SD-25	Iliuliuk Harbor		X				
SD-26	Iliuliuk Harbor		X	X			
SD-27	Iliuliuk Harbor		X				
SD-28	Iliuliuk Harbor		X	X			
SD-29	Iliuliuk Harbor		X				
SD-30	Rocky Point		X				
SD-31	Rocky Point		X				
SD-32	Rocky Point		X				
SD-33	Rocky Point		X				
SD-34	Rocky Point		X				
SD-35	Rocky Point		X				
SD-36	Rocky Point		X				
SD-37	Rocky Point		X	X	X		X
SD-38	Rocky Point		X				
SD-39	Dutch Harbor		X				
SD-40	Dutch Harbor		X				
SD-41	Dutch Harbor		X				
SD-42	Dutch Harbor		X				
SD-43	Dutch Harbor		X				
SD-44	Dutch Harbor		X				
SD-45	Dutch Harbor		X	X		X	
SD-46	Dutch Harbor		X	X			
SD-47	Dutch Harbor		X				
SD-48	Dutch Harbor		X				

Sample Location	Location Description	April 07	Sept 07	Sept 08			
				Grab			
		Grab*	Grab*	PAHs	TOC	Bioassay	Gravity core
SD-49	Dutch Harbor		X				
SD-50	Dutch Harbor		X	X			X
SD-51	Dutch Harbor		X				
SD-52	Dutch Harbor		X				
SD-53	Dutch Harbor		X	X	X		X
SD-54	Dutch Harbor		X				
SD-55	Dutch Harbor		X				
SD-56	Dutch Harbor		X	X	X		
SD-57	Dutch Harbor		X				
SD-58	Dutch Harbor		X				
SD-59	Iliuliuk Harbor			X			
SD-60	Iliuliuk Harbor			X			
SD-61	Iliuliuk Harbor			X	X		
SD-62	Iliuliuk Harbor			X			
SD-63	Iliuliuk Harbor			X	X		X
SD-64	Iliuliuk Harbor			X			
SD-65	Iliuliuk Harbor			X			
SD-66	Iliuliuk Harbor			X	X		
SD-67	Iliuliuk Harbor			X	X		
SD-68	Iliuliuk Harbor			X	X		
SD-69	Iliuliuk Harbor			X			
SD-70	Iliuliuk Harbor			X			X
SD-71	Iliuliuk Harbor			X			
SD-72	Iliuliuk Harbor			X			
SD-73	Iliuliuk Harbor			X			
SD-74	Iliuliuk Harbor			X			
SD-75	Iliuliuk Harbor			X	X		
SD-76	Iliuliuk Harbor			X	X		
SD-77	Rocky Point			X	X		X
SD-78	Dutch Harbor			X			
SD-79	Dutch Harbor			X			X
SD-80	Dutch Harbor			X			
SD-81	Dutch Harbor			X			
SD-82	Dutch Harbor			X			
SD-83	Dutch Harbor			X			
SD-84	Margaret Bay			X			
SD-85	Margaret Bay			X			
SD-86	Margaret Bay			X			

Sample Location	Location Description	April 07	Sept 07	Sept 08			
				Grab			
		Grab*	Grab*	PAHs	TOC	Bioassay	Gravity core
SD-87	Margaret Bay			X			
SD-88	Dutch Harbor			X		X	
SD-89	Rocky Point			X			
SD-90	Rocky Point			X			